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Housing Study Guild, New York

Title:

Analytic study of cost differentials for the...

Place:

New York

Date:

1935

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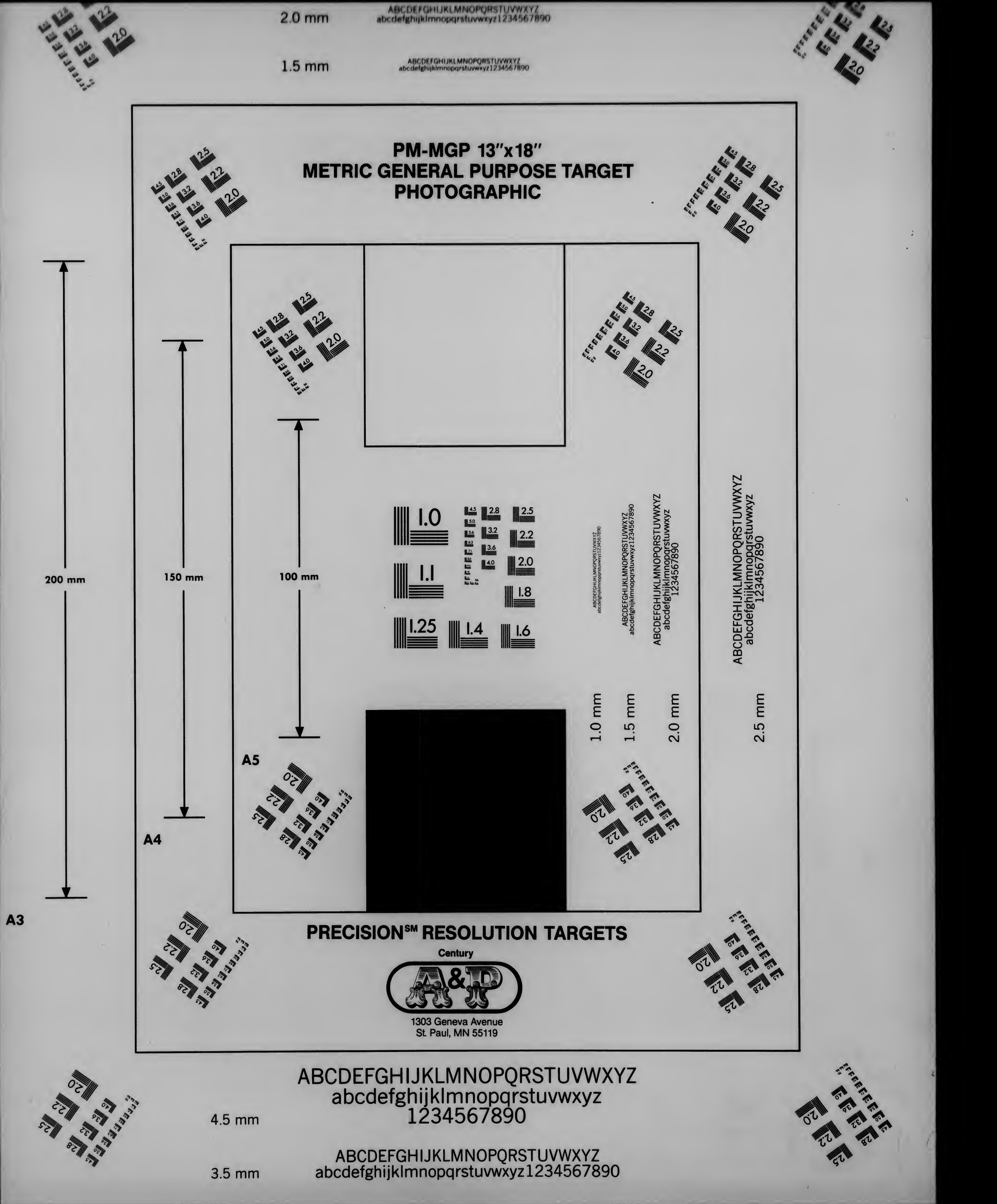
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FOR THE 2 STORY FLAT AND 2-3-4-6-8-10-12 STORY APARTMENTS

PART II: TEXT

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APR 2 . 1941

Edited by

SEBASTIAN R. RIO.

An analytic study of the characteristic changes in rental with changes in heights of buildings, with particular reference to low-cost multiple dwellings, was originated by Albert Mayer, Henry Churchill and Henry Wright. Together with a number of men (whose names are given at the end of this foreword), they formed the Analytic Committee of the Housing Study Guild, which in a series of weekly meetings laid the basic ground work for the study and criticized its execution.

During its course of development the advice and expert knowledge of technicians, engineers, apartment house managers, city planners, Utility Company experts, building material dealers and contractors were sought for guidance and in many cases for detailed figures.

The Housing Study Guild, in recognizing their invaluable assistance, is grateful to those listed below, without however involving them in any responsibility for the final results and conclusions:

Mr. George E. Strehan Mr. T. J. Foster Mr. Jacob Feld	Structural Engineers
Mr. Abraham Goldfeld Mr. J. F. Adler	Management
Mr. Percival R. Moses Mr. George D. Chadeayne	Heating and Electric Power Plant Engineers
Mr. G. De Lyle	Sewage Disposal Plant Engineer
Fellheimer & Wagner	Architects & Engineers

Mr. R. Eberlin	Utilities
Mr. J. Englebardt	Office Expense
Mr. Laurence Reiner Mr. George D. Butler	Recreation Facilities
Mr. Bimlihoff Mr. C. E. Fowler	Landscape Architects
Mr. Charles S. Haines Mr. E. Mardfin	Grounds Maintenance
Barney-Ahlers (Mr. Bekay and Mr. Glasset)	General Contractor
Taylor Fichter Co. (Mr. Cappelson)	Structural Steel Erectors
Detroit Steel Products Co.	Steel Sash
James Rose Co.	Tile Work
Weissberg & Baer (Mr. Baer) Mr. Bassman	Millwork
Fairfax Partition & Construction Co. (Mr. Holdsworth)	Metal Lath & Furring Solid Plaster Partitions
Hudson Painting & Decorating Co. (Mr. Brodsky)	Painting
Gifford Construction Co.	Excavation
Barney Schogel	Glazing
Truscon Steel Co. (Mr. Youry)	Open Truss Pressed Steel Joists
New York Cut Cast Stone Co.	Cast Stone Sills
George Colon Foundation Corporation	Excavation, Concrete & Brickwork
The New York Roofing Co. (Mr. Hand)	Roofing and Sheet Metal Work

Empire City Iron Works (Mr. Heffner)	Steel Stairs
H. Mann	Hard Wood Floors
Miller & Brown (Mr. Miller)	Electrical Equipment
Atlantic Metal Products Co. (Mr. Meisel)	Steel Covered Doors
H. D. Hynds Inc	Brick & Terra Cotta Blocks
Brady Concrete Corporation	Concrete, Brick and Tile Wall Work
The Kernerator Co. (Mr. Dean)	Incinerators
Russell & Erwin Manufacturing Co. (Mr. Jarvis)	Hardware
E. Rathe & Son Inc	Window Shades
Walter Kidde & Co	General Contractors
Atlantic Terra Cotta Co. (Mr. Hixson)	Terra Cotta Walls
Geo. E. Gibson Co. (Mr. Argast, Mr. Shea) Pollack & Nestor (Mr. Nestor)	Plumbing
Otis Elevator Co. (Mr. Schneider)	Elevators
Reynolds Metals Co	Insulated Curtain Walls
J. H. Taylor Management Co.	Janitorial Services, Repairs, Replacement, etc.
The Maintenance Co	Elevator Maintenance
Johns-Manville Co	Corrugated Cement Asbestos
Worcester & Hamilton	Plumbing
E J Electric Installation Co.	Electric Wiring
Douglas Iron Works	Steel Stairs & Misc. Iron Work

Brooklyn Edison Co. (Mr. Pratt)
New York Edison Co. (Mr. Stecker)
New York & Queens Elect. L. & P. Co. (Mr. Almquist)
Electric Current Rates

Consolidated Gas Co. of N. Y. (Mr. Pihlman)
Gas Rates

Norge Corporation (Mr. Hughes)
Electric Refrigerators

Stewart Warner Refrigerators (Mr. Ransohoff)
Electric Refrigerators

New York City Water Dept....Water Rates

Quimby Pump Co. (H. J. Callaghan)
Water Pumps

In addition, the Housing Study Guild wishes to acknowledge the assistance, in material and men, of Project #33 of the Works Division sponsored by the New York City Housing Authority, Langdon W. Post, Chairman, and under the direction of Mr. E. K. Delp, Supervising Engineer; the assistance of many men who worked, either voluntarily or for a pittance, against great odds; and in particular the heroic work of Emil W. Klee under whose direction the Charts were conceived and executed, and without whose work the Study would never have reached completion. The difficulties encountered in this study were considerably augmented by the shifting nature of the personnel. Of those listed below only three or four men saw the study through from start to finish.

THE COMMITTEE FOR THE HOUSING STUDY GUILD:

Mr. Albert Mayer
Mr. Henry Churchill
Mr. Henry Wright
Mr. Emil W. Klee
Mr. William F. R. Ballard
Mr. Charles C. Agle
Mr. Samuel S. Baum
Mr. William B. Cobb
Mr. Milton Fischer
Mr. Arthur Gallion
Mr. Werner Gottschalk
Mr. Paul Grotz
Mr. Horace Hartman
Mr. Leonard A. Panza
Mr. Samuel Ratensky
Mr. Sebastian R. Rio
Mr. Chester O. Root
Mr. Charles Ross
Mr. Joseph A. Ross
Mr. Nathaniel J. Ruzza
Mr. Charles Sulzer

THE HOUSING STUDY GUILD

The Housing Study Guild in working up and presenting this Analytic Study of the variation of cost with height of buildings (number of stories) is presenting a rational method for use anywhere in the country. Like others of its studies, such as the Rapid Method of Evaluating Differences in Monthly Rental among Different Plans, the purpose is to enable us to determine characteristic cost differences as among different schemes with a satisfactory degree of accuracy. Such facts should be part of our ready equipment as architects, and should not be matters of opinion and of more or less unimformed disputes.

Despite the fact that we know as a result of this study that an eight story building costs thirty-seven cents more in rent per room per month for the same apartment than a four story walk-up, we may still choose the eight story building for other reasons, but at least we know that the difference exists and how much it is. Unless there are local or social reasons to the contrary, we should naturally build to the number of stories which give the cheapest rental for the same accomodation. But we must emphasize that the results merely enable us to evaluate characteristic cost differences in height types; the determination of heights chosen usually depend on other considerations.

In examining this study and applying it, the following basic facts should be borne in mind:

1. All items of cost, later reduced to rent, have been considered, except land prices. The cost items come under three heads:

a. "Vertical" costs. These are the costs usually considered as construction costs to complete a building. See Charts V & VI.

b. "Horizontal" costs. These are the costs of utilities - both public and private - gas, water, sewer, electric mains, steam mains - if any - sidewalks, landscaping, etc. See Chart VII.

c. Maintenance - Operation costs for both vertical and horizontal elements. See Charts VIII, IX, and X.

2. All Cost items are figured per room,* on plans that are strictly comparable. For example, plans for every height have the same average number of rooms per apartment, thus eliminating any accidental differences in plumbing costs due to more or fewer bathrooms or kitchens; as nearly as possible rooms in all plans contain the same number of square feet. It was felt that the strip plan was the most characteristic and economical form up to and including four stories, but that for six stories and higher - that is, when an elevator was required - the cross plan was the characteristic economical form. Other investigatiors, we have found, state that they find the T-Plan

* A room is a unit of livable space which can be classified under one of the following heads: Living room, bedroom, kitchen.

more economical for heights up to four stories. Investigation of that question has not changed our viewpoint that the strip plan is comparable to the cross plan, for the purposes of this study. (See Housing Study Guild Bulletin #4)

Exactly comparable structural systems were used, except that the two-story flat was made fireproof - wall-bearing to test the economy of that special system.

The cantilever system with thin insulated exterior walls was used as a basis, not because it was found the best after exhaustive investigation but because it seemed to us that some such system had definite advantages of flexibility, space-saving, height-saving, freedom in window spacing, and flat ceiling, and that it or some variant would soon succeed the regular beam and slab and brick wall construction. For this reason we preferred to use the system throughout, even though it does not comply with the New York City building code.

Initial cost items under (a) and (b) are reduced to rent, by multiplying initial cost by a percentage which is the sum of interest rate, amortization rate and municipal tax rate. See Master Charts No. I, I-A, I-B and I-C. These charts are so constructed that easy interpolation of money rates is possible. These Master Charts are worked out in terms of rental and the additional monthly expense to the tenant for gas and electric current. These items were incorporated with the rental, because they are a necessary living cost similar to rent.

3. Attention is directed to the operating - maintenance item, so important and so often neglected as against first cost items. This is particularly important when the total living costs to the tenant are considered. It is evident that different systems of supplying heat, gas and electricity result in great variations in living economy to the tenant. These items are shown on the Master Charts No. I, I-A, I-B and I-C and Charts VIII and X which bring into striking relief the importance to the tenant's living budget of the method of production and distribution of heat, gas and electric current.

4. It should be borne in mind that major emphasis was placed on the proper comparability of plans for various heights (see Chart IV), site coverage for various heights (see Chart III) and standards of maintenance and operation, rather than the absolute merit of any plan adopted, or the absolute accuracy of any cost. At the start of the study the tendency was to take a lot of time to try to find out the best in each branch: - floor plan, site plan, etc., but it was soon realized that we should never get to the study itself. It was decided that the important issue was to make all factors comparable. Accuracy of relative differences has been maintained, - though it may well be that in maintenance-operation, for example one might differ with the absolute figures.

5. The figures were made up on the basis of a definite specification which is found attached to this report, an

outline of which appears on Chart VII and the notes column of Charts V, VI and VII; specific estimates were obtained from contractors and operating men, checked by the Guild against its own breakdown based on unit costs obtained from builders and manufacturers. In our report appear the unit prices, prices of basic materials, and wage scales, so that the figures can always be readily revised for changes in these items. Refer to pages 81-84.

6. For the New York area it appears that the four-story building results in the lowest rent (lower even than for the two-story flat, which omits janitor services). We also find that the rental in the taller buildings approximate that of the four-story building, being only slightly higher. This is a surprising result to those who have assumed that the tall building is much more costly, and shows the value of such a study.

This result is in great measure due to conditions local to New York. For instance, New York contractors are used to building tall buildings, hence methods of economy have been highly developed for them, rather than for the lower building. In some sections of the country this would not be so. Again in maintenance items, the water rate in New York is, for example, considerably higher per room for lower buildings because of the frontage rate method of charge. As a further illustration, the relative economy of systems of producing and distributing heat, electricity and gas fuel for cooking will vary in different localities where the relative costs of coal, oil, gas (and natural gas), and electricity will be quite different from what they are in New York City.

7. What has been brought out under No. 6 indicates that it would be wrong to apply the factual results of this study elsewhere without careful study. But the importance and great significance of the study are in the method evolved and employed which will be explained in further detail in section 4 of this report. Every section of the country should work out its own facts on such a method. Once the facts have been established for any locality, the results can be considered final. For unless wage rates, prices or financial rates change violently, the comparative results will not be appreciably changed. Each locality will naturally make its study for the kind of building most appropriate there - single and two-family houses, detached or semi-detached will be included; these were not included in our study because it seems unlikely that they will be considered in the New York area for the bulk of housing to be erected.

8. A good deal of attention has been paid to varying methods of production and distribution of gas, electricity and heating, because varying combinations of these have great possibilities for living economies. The gas and electricity are not technically parts of rental.

Quantitatively, the result which each system gives varies with different heights. Specifications of these various combinations into systems are included in this report and the results are discussed in Section 5.

Originally, it was our purpose to include also a study of the heating of apartments by individual heaters, as a further comparison. Aside from any possible economies inherent in the system itself, it has the great advantage of permitting each family to regulate its own heat, hence fuel consumption, hence cost. Under central system, any family pays for the average degree of heat of all families, even though it may habitually use a much lower degree. As the Guild had no member qualified to make an exhaustive study of this method, whose best development seems still in embryo, we relied, as in other fields, on the cooperation of an outside expert. He early became convinced that the individual heater could not compare with the central systems under the conditions. Unfortunately we were unable to get this gentleman to submit usable figures for comparison.

9. In listing those individuals and concerns who helped in the study, we had two purposes in mind: first to give them credit for their willing help, and second to enable those interested to check on specific items. But none of those who cooperated should be held to have any responsibility for the final results. For these the Guild alone is responsible.

Prepared by
A. MAYER.

Master Charts (I, I-A, I-B, I-C, II.)

Chart #I. Rent per Room per Month and Grand Total Paid by Tenant per Room per Month for the 2-story flats and the 2, 3, 4, 6, 8, 10, 12 story apartment buildings.

In order to show a specific application of the results of the study, the rent per room per month is computed with specific rates of interest, amortization and municipal tax, and for a specific system of heat (by owners central plant). Gas and electricity are purchased at retail rates from utility companies by tenant.

Chart #I-A. Same as I, but with rates of interest, amortization and taxes left blank for interpolation by reader.

Chart #I-B. Same as I-A, but with gas and electric fuel purchased at wholesale rates by the owner and charged to tenant at a fixed sum as part of the rental.

Chart #I-C. Same as I-B, but with electricity produced by owner's high pressure steam plant, with steam for heating as a by-product.

(Other combinations than those used as illustrations in these master charts may be desirable in specific instances.)

Chart #II. Summarized Comparisons of Rent per Room per Month.

This chart summarizes the differential in rent as caused by differing methods of supplying heat, gas and electricity. The Rent Differential per Room per Month is computed with specific rates of interest, amortization and municipal tax.

Remaining Charts.

Chart # III. Assumed diagrammatic Site Plans as used for each building height. 2-story flat, 2, 3, 4, 6, 8, 10, 12 story apartments.

Chart # IV. Floor plans of unit for each height of building.

Chart # V. Breakdown of Initial Vertical Costs per Room for the 2 story flat and the 2, 3, 4, story apartments. This shows quantities, unit prices, total prices per complete unit plan and finally the price per room.

Chart # VI. Same as Chart V for the 6, 8, 10, 12 story apartments.

Chart # VII. Initial Horizontal Project Costs per room. Also general outline description of all items whose costs enter into final rentals.

Chart # VIII. Initial costs, Operation and Maintenance Costs per Room for various heating systems combined and not combined with the generation of electricity. The results shown on this chart are made use of on charts I, I-A, I-B, I-C, V and VI.

Chart # IX. Operation and Maintenance Cost per Room per year.

Chart # X. Various Electricity and Gas Rates per Room per Year for different methods of production and distribution, and for different boroughs of New York City. (Though owned by the same holding company, the utilities have different rates in the various boroughs).

Prepared by
A. MAYER.

A. Basic plans and specifications

1. Specifications.
2. Structural frame.
3. Unit plans of buildings.
4. Site plans.
5. Systems of heating and electricity.

A-1. Specifications

The specification attached was made up to furnish a definite basis for obtaining figures on the first cost and on operation and maintenance. The effort was not to attain either a perfect specification, or one that had analyzed all the new materials and methods, but rather one that reasonably embodied up-to-date practice, and more important, one that was as uniform as reasonably possible, for all the heights of buildings studied. It was drawn by Henry S. Churchill. The specification for heating (and for heating and electric generation, which are combined in certain systems) was drawn by Messrs. P. R. Moses and G. A. Chadeayne.

As the structural system used is relatively new for this type of building, we include it here rather than have it more or less buried in the body of the specification.

A-2. Structural Frame

In consultation with Mr. Jacob Feld and Mr. George E. Strehan, structural engineers, a reinforced concrete flat slab, cantilevered at the outside of two rows of supporting structural steel H columns was adopted for the 2, 3, 4, 6, 8, 10 and 12 story apartments. The buildings are all about 26' deep from wall to wall; the columns are 17' on center, leaving a cantilever overhang of 4' on each side. A variation of the girderless concrete flat slab construction is obtained by substituting for the concrete drop and splayed heads over columns, structural steel 3" channels riveted to columns and extending out diagonally from each column corner in a horizontal plane and at an elevation where the channels are hidden within the thickness of the 6" floor slab.

The advantages of this system are the absence of exposed girders or beams at ceilings, the consequent reduction in story heights and the almost unrestricted possibilities for the design (structural and aesthetic) of a light-weight outside curtain wall. As there are no spandrel beams, window heads can be higher, with consequent better lighting. Ceilings need not be plastered. In the opinion of the engineers, the cost of the adopted structural frame is at least no greater than that of the tile arch girder and beam construction, and probably substantially less when it has become more familiar in use.

The wall-bearing construction for 2 story flat was included because Mr. Henry Wright has found that this was the cheapest and most characteristic form in certain parts of the country. The fact that it is most characteristic no doubt accounts in part for its being cheapest - people are used to building it. By the same token it does not show up quite so well in the New York area where the better grade of contractor is not used to building it.

A-3. Unit Plans of Buildings (See Chart IV)

These unit plans are as closely comparable as possible as to number of rooms per apartment and as to room sizes.

a.) 2-3-4 story apartments-strip plan, two apartments off each staircase, cross-ventilation, an average of four rooms per apartment.

b.) The 6 story one elevator and 8, 10, 12 story two elevator apartments.

Each unit contains 8 apartments (averaging 4 rooms per apartment) per floor per elevator or 2 elevators, with cross ventilation, outside corridors and partial basement.

c.) The 2 story flat.

During the early stages of the study Mr. Henry Wright submitted statistics from the Middle West which indicated the economy of the two-story wall bearing flat in first cost and maintenance. As a result a unit of this type with separate entrances and stairs to each apartment, having the same number and sizes of rooms (with cross ventilation) as the 2 story cantilever apartment, was introduced as part of this study. It should be noted that in some architects' planning, the 2 story building is proposed without a cellar. After a good deal of investigation we concluded that it was not desirable or economical to do this in our climate where large pipe trenches would be required in any case.

A-4. Site Plans (See Chart III)

The site-planning and the percent of coverage at each height directly affect the horizontal, or utility and landscape costs. For reaching a sufficiently large scale of operation, an area of 1/8 square mile (80 acres) was used in all cases. One possibility would have been to assume the same density of population housed in this area for all heights. But at 40% coverage for 2 story buildings, this would have meant about 7% coverage for 12 story buildings, which we considered as absurdly low, and in some respects even an undesirable figure for habitual urban living. Therefore we adopted coverages that in our judgement seemed comparably satisfactory, though this is by no means demonstrable. These are:

Building Height	2 Story	3 Story	4 Story	6 Story
% of Coverage	40	36	32	28
Population housed (at one person per room)	11136	14400	16128	20736

Building Height	8 Story	10 Story	12 Story
% of Coverage	24	20	16
Population housed (at one person per room)	24576	26880	27648

The 80-acre site was divided into 12 blocks, all measuring about 375' X 595'each. The streets were established at 40' wide for buildings up to three stories in height, 60' wide for the 4 and 6 story buildings, and 80' wide for the 8, 10 and 12 story buildings. The size of recreational areas shown (diagramatically only) varies directly with the number of people housed - i.e. the same area per person was allowed for each building height.

After intensive study and due to necessary adjustments the coverages, block sizes and street widths varied somewhat in the adopted site plans, for which are claimed reasonable amenities as to sunlight and privacy - and economy for the installation of distribution systems and sewage disposal lines.

The site-planning and coverage have been described in such detail because it is realized that here, as in some of our other assumptions, others might differ from us in our opinion as to what would be comparable and we wanted to present enough data so that each person could draw his own conclusions. In any case, a difference in site planning and coverage affects only the horizontal costs which will be seen to be the smallest factor in the final result.

A-5. Systems of Heating (and Hot Water) and Electricity and Gas Fuel.

There are three reasons for what might be considered the disproportionate emphasis we have placed on various methods of producing and distributing heat, electricity and gas:

a. Study of combinations of these items other than the systems that are traditional for any locality, appears to us to offer greater possibilities for savings in living costs than any other item in shelter that is either immediately available or technologically imminent.

b. Such a study brings into clear relief the absurdities in the rate structures of the utilities. For example in one borough of the city, electric current can be purchased wholesale and sub-metered to tenants; in another borough this is not allowed.

c. It is clear that the present set-up of electric utilities with large, widely scattered central plants and high distribution costs, cannot compete with local generating plants in large housing developments, which can use high pressure steam for generating electricity, and the exhaust for steam heat. It would seem that the utilities should take cognizance of this fact and shape their future development to take account of this.

The five combinations explored are described in detail in the right-hand column of Chart VIII. This is a summary:

System #1: Coal fired boiler in each building for heat and hot water, single pipe steam. Electric current purchased by tenant direct from utility company at retail rates.

System #2: Same as #1, except that boilers are oil-fired.

System #3: Central heating and electric plant, single pipe steam. One plant is capable of supplying heat and electricity to six blocks. Plant uses oil or pulverized coal as fuel.

System #4: Same as #3, except that steam is distributed to hot water circuits in each building for hot water heating. This system was devised by Mr. Chadeayne.

System #5: Same as system #3, except that steam is produced for heating only, electric current purchased by tenant direct from utility company at retail rates.

Gas Fuel can be obtained by the tenant in two ways:

1. The tenant purchases the gas directly from the utility company at retail rates.

2. The owner purchases the gas from the utility company at wholesale rates, and sells it to the tenant. The tenant pays for it in the form of rent.

For description and costs of the variables for heat, electricity and gas a reference table is given (Page 23).

B. Detailed Outline of Procedure and Content for All Items in the Study.

1. Initial Vertical Building Costs.
2. Horizontal Project Costs.
3. Maintenance Factors.
4. The Variables.
5. General Description of Vertical and Horizontal Elements - Operating Characteristics.

B-1. Initial Vertical Building Costs (Refer to Charts V and VI.)

In order that costs for the various height buildings might be comparable, quantity take-offs for all buildings

VARIABLE	Initial Vertical Costs	General Description of Vertical Elements	Initial Horizontal Costs	General Description of Horizontal Elements	Operation and Maintenance Costs (Vertical and Horizontal Elements)	Description of Operating Characteristics	General Notes
HEAT	Chart VIII	Chart VIII	Chart VIII	Chart VIII	Chart VIII	Chart VIII	
ELECTRICITY	Charts V & VI (Below Totals) Items III-1, III-2, III-3, III-4, IV-1, IV-2	Chart VII Items D-1, D-2, D-3, D-4	Chart VII (Below Totals) Items II-1, II-2, II-3, II-4	Chart VII Items E VI-1 E VI-2 E VI-3	Chart IX below totals Items II-1, II-2, II-3, 11-4, III-1, III-2, III-3, III-4 Chart 10	Chart VII Items G-1, G-2, G-3, G-4, G-5, Chart X	In vertical costs only meters, pans and loops are affected. The vertical electric lines remain constant.
GAS	Charts V & VI (Below Totals) Items II-1, II-2	Chart VIII Items C-1 C-2	Remain Constant	Chart VII Items E V-1 E V-2	Chart IX (below totals) Items IV-1 & IV-2	Chart VII Items G-1 & G-2	In Horinzontal costs no perceptable change occurs for either system.

were made and checked by the same group. Mr. Paul Grotz obtained costs for all story height buildings (in a quantity basis of 5000 rooms) from Barney-Ahlers, acting in the capacity of general contractors, and from sub-contractors listed elsewhere in this report.

B-2. Horizontal Project Costs (Refer to Chart VII)

Using the adopted site plans for each story height buildings, cost data was obtained by the following procedure:

a. Horizontal sewage, gas and water lines

Distribution system layouts were made for all building heights, quantity take-offs executed, unit prices obtained from plumbing contractors and costs calculated. (L. A. Panza)

b. Horizontal electric distribution systems when electric current is purchased from utility companies.

In consultation with utility company representatives, distribution lines for the various height buildings were indicated on the site plans and costs obtained from the utility companies and electrical contractors
(Chester Root and W. B. Cobb).

c. Horizontal heat distribution system and electric distribution systems when electric current is generated on the site.

Messrs. P. R. Moses and G. D. Chadeayne in collaboration with the Housing Study Guild designed and calculated costs (of both vertical and horizontal elements) for various systems of heating, two of which include electric generating plants and horizontal electric distribution systems.

An analysis of these systems is given in Chart VIII from which the horizontal costs were transferred to Horizontal project costs Chart VII, and vertical costs were transferred to Vertical project charts, Charts V and VI.

d. Landscaping and Sidewalks (Chart VII)

Unit prices were obtained from Mr. Ralph Eberlin of the City Housing Corporation and costs calculated. (S. R. Rio)

B-3. Maintenance Factors: (Refer to Chart IX)

In order to arrive at a reasonably satisfactory solution to the operation and maintenance factors the experience of various apartment group buildings and grounds managers and other maintenance experts listed elsewhere in this report was drawn upon for guidance. Necessarily the experiences of most of those consulted had to do with apartment groups for tenants commanding higher incomes than those for whom the low cost housing is intended to provide shelter.

The total maintenance costs include the electric current for public space light and power only. The cost of electric current and gas used by tenants within the apartments may be obtained from Chart X.

We were unable to find any adequate data for operation - maintenance costs for the horizontal elements (Utilities, etc.) They appear to be so bound up with other city costs and other costs of utility operation that we could not, without expenditure of a disproportionate time on research into this one item, get anything even remotely like accurate. We simply assumed an operation - maintenance cost of 3% of the initial cost.

B-4. The Variables - Heat, Electricity and Gas

Initial and maintenance costs are influenced by the selection of heating system combined or not combined with an electric generating plant and by methods of purchasing gas fuel and electric current from Utility Companies.

As a consequence rent per room per month for the same low cost housing project built of the same structural material will vary according to the selection of the variables - heat, electricity and gas.

Cost variables which are set down on the charts are enumerated below.

I. Heading

I. Heating

Initial, Maintenance and Operating Costs for both vertical and horizontal elements of five heating systems for two of these electricity is generated and exhaust steam is used for heating.

For complete description of each and for further analysis refer to Chart VIII.

II. Gas Fuel

a. Initial Vertical Costs for gas lines.

1. When gas is purchased at retail rates.
2. " " " " " wholesale rates.

For costs refer to bottom of Charts V & VI.

For description refer to Chart VII, item C.

Note: When gas is purchased at retail rates and individual meters located in the basement or ground floor as prescribed, separate risers must lead to each apartment, whereas when gas is purchased at wholesale rates one conveniently located riser may supply many apartments.

With either method of purchasing gas fuel no perceptible cost change occurs in the horizontal distribution systems and these costs are considered constant.

For description refer to Chart VII items E.-V.

b. Maintenance costs for vertical elements of gas lines.

1. When gas is purchased at retail rates.
2. " " " " " wholesale rates.

For costs refer to bottom of Chart IX.

Note: Regardless of how gas fuel is purchased there is no perceptible change in the horizontal distribution system and therefore maintenance costs are considered constant.

III. Electric Current

a. Initial Vertical Costs for Meter Pans and loops.

1. Individual metering of electric current.
2. Sub-metering of electric current.*
3. Master metering of electric current.**
4. Metering of electric current when generated on the site.

For costs refer to bottom of Charts V and VI.

For description refer to Chart VII - item D.

b. Initial Vertical costs for electric meters.

1. Sub-metering of electric current.
2. Individual metering when electricity is generated on the site.

For costs refer to bottom of Charts V and VI.

For description refer to Chart VII - item D.

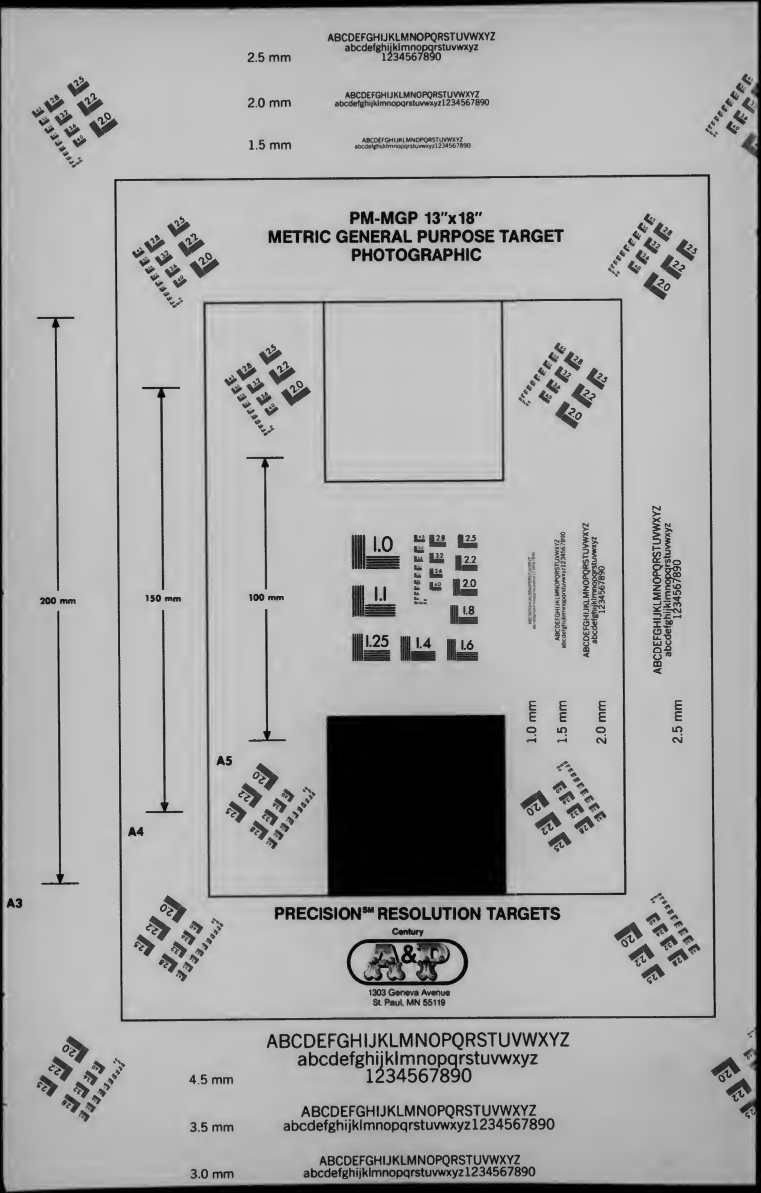
* The owner purchases electric current at wholesale rates and submeters it to the tenants. Tenants pay to owner.

**The owner purchases electric current at wholesale rates and pro-rates the charge to the tenants. The tenants pay in the form of rent.

REDUCTION

RATIO

28:1

ABCDEFGHIJKLMNOPQRSTUVWXYZ
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• KEY TO SET-UP OF MASTER CHARTS I, I-A, I-B, I-C AND II, BY EXAMPLE. APPLIED TO THE 6 STORY CANTILEVER APARTMENTS • INITIAL VERTICAL COSTS GIVEN ON CHARTS VI AND VIII •

	ITEM A	ITEM B	ITEM C	ITEM D	ITEM E	ITEM F	ITEM G	ITEM H	ITEM J	ITEM K
COMBINATION A CHART I & I-A RENT PER ROOM PER MONTH-LAND EXCLUDED- WHEN HEAT IS FURNISHED BY OWNERS CENTRAL PLANT AND ELECTRIC CURRENT AND GAS ARE PURCHASED FROM UTILITY COMPANIES BY TENANT AT RETAIL RATES- THE ELECTRIC CURRENT AND GAS CHANGES ARE PAID NY THE TENANT IN ADDITION TO THE RENT.	TOTAL INITIAL VERTICAL COSTS — VARIABLES INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS. 41.91 INITIAL VERTICAL COSTS OF GAS LINES- INDIVIDUAL METERING 7.00 ELECTRIC METER PANS AND LOOPS- INDIVIDUAL METERING .94 6 STORY APT. CHART VI. TOTAL 679.05 MINUS ---------- 49.85 = 629.20 = A	HEAT INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS. FROM CHART VIII SYSTEM 5 6 STORY APT. INITIAL COSTS FIND VERTICAL COSTS 28.15 PLANT COSTS 13.76 41.91 = B	GAS INITIAL VERTICAL COSTS OF GAS LINES- INDIVIDUAL METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS- II. INITIAL VERTICAL COSTS OF GAS LINES 1. INDIVIDUAL METERING = 7.00 = C FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS- INDIVIDUAL METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS- III. ELECTRIC METER PANS & LOOPS-1. INDIVIDUAL METERING- ELECTNICITY PUNCHASED = .94 = D FOR 6 STORY APT.	TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII. TOTAL 17.55 NOTES- NO SUBSTITUTIONS ARE REQUIRED FOR COMBINATION A SINCE THE VARIABLE ITEMS USED ON CHART VII ARE THOSE USED IN COMBINATION A.	GAS FUEL COSTS INDIVIDUALLY METERED FROM CHART X. GAS FUEL INDIVIDUAL METERING FOR 6 STORY APT. FIND $5.17 PER YEAR = F.	ELECTRIC CURRENT USED BY THE TENANT WITHIN THE APARTMENT. FROM CHART X. ELECTRIC CURRENT. N.Y. & Q.E.L. & P.CO. INDIVIDUAL METERING- TENANTS LIGHTS & REFRIGERATORS FOR THE 6 STORY APARTMENT FIND $11.72 PER YEAR = G. ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. N.Y. & Q.E.L. & P.CO. INDIVIDUAL METERING- PUBLIC SPACE LIGHT & POWER FOR THE 6 STORY APARTMENT FIND $2.96 PER YEAR = G.	CITY WATER FROM CHART IX MAINTENANCE COST ITEM- CITY WATER- FOR 6 STORY APT. FIND $2.53 PER YEAR = H.	HEAT AND DOMESTIC HOT WATER. FROM CHART VIII. MAINTENANCE AND OPERATION COSTS-TOTAL RENT PER ROOM PER YEAR- SYSTEM NO. 5- 6 STORY APT. FIND $6.92 PER YEAR = J.	TOTAL MAINTENANCE & OPERATION COSTS — VARIABLES AND ONE CONSTANT- CITY WATER PUBLIC SPACE LIGHT & POWER 2.96 CITY WATER 2.53 HEAT & DOMESTIC HOT WATER. 6.92 6 STORY APT. CHART IX. TOTAL $42.64 MINUS 12.41 = 30.23 PER YEAR = K.
COMBINATION B CHART I-B RENT PER ROOM PER MONTH-LAND EXCLUDED- WHEN HEAT IS FURNISHED BY OWNERS CENTRAL PLANT AND ELECTRIC CURRENT AND GAS ARE PURCHASED FROM UTILITY COMPANIES BY OWNER AT WHOLESALE RATES- THE ELECTRIC CURRENT AND GAS CHARGES ARE REFLECTED IN THE TENANTS RENT.	SAME AS FOR COMBINATION A.	HEAT SAME AS FOR COMBINATION A	GAS INITIAL VERTICAL COSTS OF GAS LINES- MASTER METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS- II. INITIAL VERTICAL COSTS OF GAS LINES 2. MASTER METERING = 4.70 = C FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS- MASTER METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS- III. ELECTRIC METER PANS & LOOPS-2. MASTER METERING- ELECTRICITY PURCHASED = .00 = D FOR 6 STORY APT.	{TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII.} — VARIABLE (ONLY ONE CHANGES) ● {ELECTRIC LINES INDIVIDUAL METERING} = {INITIAL HORIZONTAL PROJECT COST MINUS ELECTRIC LINES} + {SUBSTITUTED COST ITEM FOR ELECTRIC LINES- MASTER METERING. FROM CHART VII BELOW TOTAL HORIZONTAL PROJECT COSTS FIND INTERCHANGEABLE VARIATIONS-II ELECTRIC LINES-3. MASTER METERING 2.64 FOR 6 STORY APT.} TOTAL 17.55 MINUS 1.25 = 16.30 + 2.64 = 18.94 = E	GAS FUEL COSTS MASTER METERING FROM CHART X. GAS FUEL MASTER METERING FOR 6 STORY APT. FIND $4.32 PER YEAR = F.	ELECTRIC CURRENT FOR APARTMENT USE AND PUBLIC SPACE LIGHT AND POWER. FROM CHART X:- ELECTRIC CURRENT N.Y. & Q.E.L. & P.CO.- MASTER METERING. FIND:- PUBLIC SPACE LIGHT AND POWER 2.13 TENANTS LIGHTS AND REFRIGERATORS 6.10 8.23 PER YEAR = G FOR 6 STORY APT.	CITY WATER SAME AS FOR COMBINATION A	HEAT AND DOMESTIC HOT WATER. SAME AS FOR COMBINATION A.	TOTAL MAINTENANCE & OPERATION COSTS — VARIABLES AND ONE CONSTANT- CITY WATER PUBLIC SPACE LIGHT & POWER 2.96 CITY WATER 2.53 HEAT & DOMESTIC HOT WATER 6.92 GAS LINES-VERTICAL ELEMENTS INDIVIDUAL METERING. .21 TOTAL MAINT. & OPERATION COSTS MINUS ITEMS SUBTRACTED + SUBSTITUTED GAS LINES- VERTICAL ELEMENTS FOR MASTER METER. 6 STORY APT. CHART IX. TOTAL $42.64 MINUS [illegible] = [illegible] + .16 = [illegible] PER YEAR = K.
COMBINATION C CHART I-C RENT PER ROOM PER MONTH-LAND EXCLUDED-WHEN HEAT AND ELECTRIC CURRENT ARE FURNISHED BY OWNERS CENTNAL PLANT AND GAS IS PURCHASED FNOM UTILITY COMPANY BY OWNER AT WHOLESALE RATES- THE GAS COST IS REFLECTED IN THE TENANTS RENT AND THE ELECTRIC CURRENT PAID BY TENANT IN ADDITION TO RENT.	SAME AS FOR COMBINATION A.	HEAT INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS & ELECTRIC GENERATING PLANT. FROM CHART VIII SYSTEM 3 6 STORY APT. INITIAL COSTS FIND HEAT VENTICAL COSTS 28.15 PLANT COSTS 13.76 ELECTRIC PLANT COSTS 9.29 51.20 = B	GAS SAME AS FOR COMBINATION B	ELECTRIC ELECTRIC METER PANS & LOOPS- INDIVIDUAL METERING- ELECTRICITY GENERATED ON SITE FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS- III. ELECTRIC METER PANS & LOOPS-4. INDIVIDUAL METERING- ELECTRICITY GENERATED BY OWNER = .75 = D FOR 6 STORY APT.	{TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII.} — VARIABLE (ONLY ONE CHANGES) ▲ {ELECTRIC LINES INDIVIDUAL METERING} = {INITIAL HORIZONTAL PROJECT COST MINUS ELECTRIC LINES} + {SUBSTITUTED COST ITEM FOR ELECTRIC LINES- ELECTRICITY GENERATED BY OWNERS CENTRAL PLANT. FROM CHART VIII- INITIAL COSTS- ELECTRIC HORIZONTAL COSTS 9.29 FOR 6 STORY APT.} TOTAL 17.55 MINUS 1.25 = 16.30 + 4.52 = 20.82 = E	GAS FUEL COSTS SAME AS FOR COMBINATION B.	ELECTRIC CURRENT USED BY THE TENANT WITHIN THE APARTMENT. FROM CHART X. ELECTRIC CURRENT PRIVATELY OWNED GENERATING PLANT- INDIVIDUAL METERING- TENANTS LIGHTS ● AND REFRIGERATORS- FIND $1.37 PER YEAR G. ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. PRIVATELY OWNED GENERATING PLANT-● INDIVIDUAL METERING- PUBLIC SPACE LIGHT AND POWER. FIND $.74 PER YEAR G.	CITY WATER SAME AS FOR COMBINATION A	HEAT AND DOMESTIC HOT WATER. FROM CHART VIII. MAINTENANCE AND OPERATION COSTS-TOTAL RENT PER ROOM PER YEAR- SYSTEM NO. 3- FIND $9.03. THIS INCLUDES MAINTENANCE AND OPENATION COSTS FOR ELECTRICITY. SINCE THE HEAT AND DOMESTIC HOT WATER PORTION OF SYSTEM NO. 3 IS IDENTICAL WITH SYSTEM NO. 5 ● USE FIGURE FOR SYSTEM NO. 5 WHICH IS $6.92 PER YEAR = J.	SAME AS FOR COMBINATION A.
			NOTE- WHEN GAS FUEL IS INDIVIDUALLY METERED A SEPARATE GAS LINE MUST GO TO EACH APARTMENT. WHEN MASTER METERED ONE LINE MAY FEED MANY APARTMENTS.	NOTE- FOR COMBINATION C COST OF ELECTRIC METER IS INCLUDED WITH ELECTRIC PLANT COSTS ALREADY TAKEN CARE OF UNDER ITEM B.	● SAME SYSTEM OF HEAT USED AS FOR COMBINATION A THEREFORE NO SUBSTITUTION IN HEAT LINES. ▲ HORIZONTAL HEATING LINE COSTS ARE THE SAME FOR BOTH SYSTEM 3 & 5 THEREFORE NO SUBSTITUTION. SEE CHART VIII. SYSTEM 5 IS USED FOR COMBINATIONS A AND B AND SYSTEM 3 FOR COMBINATION C. SINCE THERE IS NO PERCEPTIBLE CHANGE IN THE GAS LINE DISTRIBUTION SYSTEMS FOR INDIVIDUALLY METERED OR MASTER METERED GAS. THESE LINES REMAIN CONSTANT IN COST.		● THE ELECTRIC CURRENT COSTS FOR COMBINATION C WERE TRANSFERRED TO CHART X FROM CHART VIII.	NOTES:- CITY WATER COSTS ALTHOUGH CONSTANT WERE SEPARATED FOR THE PURPOSE OF GRAPHICALLY ILLUSTRATING ON CHARTS I, I-A, I-B, I-C OPERATION AND MAINTENANCE ITEMS FOR WHICH THE OWNER DOES NOT FURNISH THE LABOR.	● SINCE THE COSTS OF GENERATING ELECTRIC CURRENT ARE THE COSTS OF FUEL AND LABOR OVER AND ABOVE THAT REQUIRED FOR HEATING THIS SUBSTITUTION IS PERMISSIBLE.	NOTES.- MAINTENANCE FACTORS FOR ELECTRIC GENERATOR ARE INCLUDED IN THE ELECTRIC CURRENT COSTS. NO MAINTENANCE COSTS WERE OBTAINABLE FOR ELECTRIC DISTRIBUTION LINES AND IN THIS STUDY WERE CONSIDERED AS ZERO.

REDUCTION

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PRECISION℠ RESOLUTION TARGETS

Century
A&P
1303 Geneva Avenue
St. Paul, MN 55119

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• KEY TO SET-UP OF MASTER CHARTS I, I-A, I-B,

	ITEM A	ITEM B	ITEM C	ITEM D	
COMBINATION A CHART I & I-A RENT PER ROOM PER MONTH-LAND EXCLUDED- WHEN HEAT IS FURNISHED BY OWNERS CENTRAL PLANT AND ELECTRIC CURRENT AND GAS ARE PURCHASED FROM UTILITY COMPANIES BY TENANT AT RETAIL RATES- THE ELECTRIC CURRENT AND GAS CHARGES ARE PAID BY THE TENANT IN ADDITION TO THE RENT.	TOTAL INITIAL VERTICAL COSTS — VARIABLES INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS. 41.91 INITIAL VERTICAL COSTS OF GAS LINES-INDIVIDUAL METERING 7.00 6 STORY APT. CHART VI. ELECTRIC METER PANS AND LOOPS-INDIVIDUAL METERING .94 TOTAL 679.05 MINUS - - - - - - - - - - - - - - - - 49.85 = 629.20 = A	HEAT INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS. FROM CHART VIII SYSTEM 5 6 STORY APT. INITIAL COSTS FIND VERTICAL COSTS 28.15 PLANT COSTS 13.76 41.91 = B	GAS INITIAL VERTICAL COSTS OF GAS LINES-INDIVIDUAL METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-II. INITIAL VERTICAL COSTS OF GAS LINES I. INDIVIDUAL METERING = 7.00 = C FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS-INDIVIDUAL METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-I. INDIVIDUAL METERING-ELECTRICITY PURCHASED = .94 = D FOR 6 STORY APT.	TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII. TOTAL 17.55
COMBINATION B CHART I-B RENT PER ROOM PER MONTH-LAND EXCLUDED- WHEN HEAT IS FURNISHED BY OWNERS CENTRAL PLANT AND ELECTRIC CURRENT AND GAS ARE PURCHASED FROM UTILITY COMPANIES BY OWNER AT WHOLESALE RATES- THE ELECTRIC CURRENT AND GAS CHARGES ARE REFLECTED IN THE TENANTS RENT.	SAME AS FOR COMBINATION A.	SAME AS FOR COMBINATION A	GAS INITIAL VERTICAL COSTS OF GAS LINES-MASTER METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-II. INITIAL VERTICAL COSTS OF GAS LINES 2. MASTER METERING = 4.70 = C FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS-MASTER METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-2. MASTER METERING-ELECTRICITY PURCHASED = .00 = D FOR 6 STORY APT.	TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII. — VARIABLE (ONLY ONE CHANGES) ● TOTAL 17.55 MINUS
COMBINATION C CHART I-C RENT PER ROOM PER MONTH-LAND EXCLUDED-WHEN HEAT AND ELECTRIC CURRENT ARE FURNISHED BY OWNERS CENTRAL PLANT AND GAS IS PURCHASED FROM UTILITY COMPANY BY OWNER AT WHOLESALE RATES- THE GAS COST IS REFLECTED IN THE TENANTS RENT AND THE ELECTRIC CURRENT PAID BY TENANT IN ADDITION TO RENT.	SAME AS FOR COMBINATION A.	HEAT INITIAL VERTICAL HEATING & DOMESTIC HOT WATER COSTS & ELECTRIC GENERATING PLANT. FROM CHART VIII SYSTEM 3 6 STORY APT. INITIAL COSTS FIND HEAT VERTICAL COSTS 28.15 PLANT COSTS 13.76 ELECTRIC PLANT COSTS 9.29 51.20 = B	GAS SAME AS FOR COMBINATION B	ELECTRIC ELECTRIC METER PANS & LOOPS-INDIVIDUAL METERING-ELECTRICITY GENERATED ON SITE FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-4. INDIVIDUAL METERING-ELECTRICITY GENERATED BY OWNER = .75 = D FOR 6 STORY APT.	TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII. — VARIABLE (ONLY ONE CHANGES) ▲ TOTAL 17.55 MINUS
			NOTE- WHEN GAS FUEL IS INDIVIDUALLY METERED A SEPARATE GAS LINE MUST GO TO EACH APARTMENT. WHEN MASTER METERED ONE LINE MAY FEED MANY APARTMENTS.	NOTE- FOR COMBINATION C COST OF ELECTRIC METER IS INCLUDED WITH ELECTRIC PLANT COSTS ALREADY TAKEN CARE OF UNDER ITEM B.	● SAME SYSTEM OF HEAT US HEAT LINES. ▲ HORIZONTAL HEATING LI NO SUBSTITUTION. SEE C AND SYSTEM 3 FOR COMBI SINCE THERE IS NO PERC FOR INDIVIDUALLY METER IN COST.

• KEY TO SET-UP OF MASTER CHARTS I, I-A, I-B, I-C AND II, BY EXAMPLE. APPLIED TO THE 6 STORY CANTILEVER APARTMENTS • INITIAL VERTICAL COSTS GIVEN ON CHART

TEM C	ITEM D	ITEM E	ITEM F	ITEM G	ITEM
AS RTICAL COSTS IES- METERING. VI BELOW TAL INITIAL INTERCHANGE- TIONS- VERTICAL AS LINES AL METERING = FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS-INDIVIDUAL METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-I. INDIVIDUAL METERING-ELECTRICITY PURCHASED = .94 = D FOR 6 STORY APT.	TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII. TOTAL 17.55 NOTE:- NO SUBSTITUTIONS ARE REQUIRED FOR COMBINATION A SINCE THE VARIABLE ITEMS USED ON CHART VII ARE THOSE USED IN COMBINATION A.	GAS FUEL COSTS INDIVIDUALLY METERED FROM CHART X. GAS FUEL INDIVIDUAL METERING FOR 6 STORY APT. FIND $5.17 PER YEAR = F.	ELECTRIC CURRENT USED BY THE TENANT WITHIN THE APARTMENT. FROM CHART X. ELECTRIC CURRENT. N.Y. & Q.E.L. & P.CO. INDIVIDUAL METERING-TENANTS LIGHTS & REFRIGERATORS FOR THE 6 STORY APARTMENT FIND $11.72 PER YEAR = G. ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. N.Y. & Q.E.L. & P.CO. INDIVIDUAL METERING-PUBLIC SPACE LIGHT & POWER FOR THE 6 STORY APARTMENT FIND $2.96 PER YEAR = G.	CITY WATE FROM CHART IX MA COST ITEM- CITY FOR 6 STORY APT. $2.53 PER YEAR =
AS RTICAL COSTS NES- TERING. VI BELOW TAL INITIAL INTERCHANGE- ATIONS- VERTICAL GAS LINES METERING = FOR 6 STORY APT.	ELECTRIC ELECTRIC METER PANS & LOOPS-MASTER METERING. FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-2. MASTER METERING-ELECTRICITY PURCHASED = .00 = D FOR 6 STORY APT.	{TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII.} – VARIABLE (ONLY ONE CHANGES) ● {ELECTRIC LINES INDIVIDUAL METERING} = {INITIAL HORIZONTAL PROJECT COST MINUS ELECTRIC LINES} + {SUBSTITUTED COST ITEM FOR ELECTRIC LINES-MASTER METERING. FROM CHART VII BELOW TOTAL HORIZONTAL PROJECT COSTS FIND INTERCHANGEABLE VARIATIONS-II ELECTRIC LINES-3. MASTER METERING 2.64 FOR 6 STORY APT.} TOTAL 17.55 MINUS 1.25 = 16.30 + 2.64 = 18.94 = E	GAS FUEL COSTS MASTER METERING FROM CHART X. GAS FUEL MASTER METERING FOR 6 STORY APT. FIND $4.32 PER YEAR = F.	ELECTRIC CURRENT FOR APARTMENT USE AND PUBLIC SPACE LIGHT AND POWER. FROM CHART X:- ELECTRIC CURRENT N.Y. & Q.E.L. & P.CO.- MASTER METERING. FIND:- PUBLIC SPACE LIGHT AND POWER 2.13 TENANTS LIGHTS AND REFRIGERATORS 6.10 8.23 PER YEAR = G FOR 6 STORY APT.	CITY WATE SAME AS FOR COM
GAS OR COMBINATION B	ELECTRIC ELECTRIC METER PANS & LOOPS-INDIVIDUAL METERING-ELECTRICITY GENERATED ON SITE FROM CHART VI BELOW LINE OF TOTAL INITIAL COSTS FIND INTERCHANGEABLE VARIATIONS-III. ELECTRIC METER PANS & LOOPS-4. INDIVIDUAL METERING-ELECTRICITY GENERATED BY OWNER = .75 = D FOR 6 STORY APT.	{TOTAL INITIAL HORIZONTAL PROJECT COSTS 6 STORY APT. CHART VII.} – VARIABLE (ONLY ONE CHANGES) ▲ {ELECTRIC LINES INDIVIDUAL METERING} = {INITIAL HORIZONTAL PROJECT COST MINUS ELECTRIC LINES} + {SUBSTITUTED COST ITEM FOR ELECTRIC LINES-ELECTRICITY GENERATED BY OWNERS CENTRAL PLANT. FROM CHART VIII- INITIAL COSTS- ELECTRIC HORIZONTAL COSTS 9.29 FOR 6 STORY APT.} TOTAL 17.55 MINUS 1.25 = 16.30 + 4.52 = 20.82 = E	GAS FUEL COSTS SAME AS FOR COMBINATION B.	ELECTRIC CURRENT USED BY THE TENANT WITHIN THE APARTMENT. FROM CHART X. ELECTRIC CURRENT PRIVATELY OWNED GENERATING PLANT-INDIVIDUAL METERING-TENANTS LIGHTS ● AND REFRIGERATORS-FIND $1.37 PER YEAR G. ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. PRIVATELY OWNED GENERATING PLANT-● INDIVIDUAL METERING-PUBLIC SPACE LIGHT AND POWER. FIND $.74 PER YEAR G.	CITY WAT SAME AS FOR COM
N GAS FUEL IS LLY METERED A GAS LINE MUST H APARTMENT. N MASTER NE LINE MAY APARTMENTS.	NOTE- FOR COMBINATION C COST OF ELECTRIC METER IS INCLUDED WITH ELECTRIC PLANT COSTS ALREADY TAKEN CARE OF UNDER ITEM B.	● SAME SYSTEM OF HEAT USED AS FOR COMBINATION A THEREFORE NO SUBSTITUTION IN HEAT LINES. ▲ HORIZONTAL HEATING LINE COSTS ARE THE SAME FOR BOTH SYSTEM 3 & 5 THEREFORE NO SUBSTITUTION. SEE CHART VIII. SYSTEM 5 IS USED FOR COMBINATIONS A AND B AND SYSTEM 3 FOR COMBINATION C. SINCE THERE IS NO PERCEPTIBLE CHANGE IN THE GAS LINE DISTRIBUTION SYSTEMS FOR INDIVIDUALLY METERED OR MASTER METERED GAS. THESE LINES REMAIN CONSTANT IN COST.		● THE ELECTRIC CURRENT COSTS FOR COMBINATION C WERE TRANSFERRED TO CHART X FROM CHART VIII.	NOTE:- CITY WATER C CONSTANT WERE S THE PURPOSE OF ILLUSTRATING ON I-A, I-B, I-C O MAINTENANCE ITE THE OWNER DOES THE LABOR.

TS • INITIAL VERTICAL COSTS GIVEN ON CHARTS VI AND VIII •

ITEM G	ITEM H	ITEM J	ITEM K
TENANT ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. N.Y. & Q.E.L. & P.CO. INDIVIDUAL METERING- RS FOR PUBLIC SPACE LIGHT & POWER FOR THE 11.72 6 STORY APARTMENT FIND $2.96 PER YEAR = G.	CITY WATER FROM CHART IX MAINTENANCE COST ITEM- CITY WATER- FOR 6 STORY APT. FIND $2.53 PER YEAR = H.	HEAT AND DOMESTIC HOT WATER. FROM CHART VIII. MAINTENANCE AND OPERATION COSTS-TOTAL RENT PER ROOM PER YEAR- SYSTEM NO. 5- 6 STORY APT. FIND $6.92 PER YEAR = J.	TOTAL MAINTENANCE & OPERATION COSTS 6 STORY APT. CHART IX. — { VARIABLES AND ONE CONSTANT- CITY WATER { PUBLIC SPACE LIGHT & POWER 2.96 CITY WATER 2.53 HEAT & DOMESTIC HOT WATER. 6.92 TOTAL $42.64 MINUS 12.41 = 30.23 PER YEAR = K.
RTMENT USE AND PUBLIC SPACE LIGHT AND POWER. RENT N.Y. & Q.E.L. & P.CO.- MASTER METERING. POWER 2.13 RIGERATORS 6.10 8.23 PER YEAR = G FOR 6 STORY APT.	CITY WATER SAME AS FOR COMBINATION A	HEAT AND DOMESTIC HOT WATER. SAME AS FOR COMBINATION A.	TOTAL MAINTENANCE & OPERATION COSTS 6 STORY APT. CHART IX. — { VARIABLES AND ONE CONSTANT- CITY WATER { PUBLIC SPACE LIGHT & POWER 2.96 CITY WATER 2.53 HEAT & DOMESTIC HOT WATER 6.92 GAS LINES-VERTICAL ELEMENTS INDIVIDUAL METERING. .21 = { TOTAL MAINT. & OPERATION COSTS MINUS ITEMS SUBTRACTED } + { SUBSTITUTED GAS LINES. VERTICAL ELEMENTS FOR MASTER METER. TOTAL $42.64 MINUS 12.62 = 30.02 + .14 = 30.16 PER YEAR = K.
TENANT ELECTRIC CURRENT FOR PUBLIC SPACE LIGHT & POWER. FROM CHART X. ELECTRIC CURRENT. PLANT- PRIVATELY OWNED GENERATING PLANT-● INDIVIDUAL METERING- ERATORS- PUBLIC SPACE LIGHT AND POWER. FIND $.74 PER YEAR G.	CITY WATER SAME AS FOR COMBINATION A	HEAT AND DOMESTIC HOT WATER. FROM CHART VIII. MAINTENANCE AND OPERATION COSTS-TOTAL RENT PER ROOM PER YEAR- SYSTEM NO. 3- FIND $9.03. THIS INCLUDES MAINTENANCE AND OPERATION COSTS FOR ELECTRICITY. SINCE THE HEAT AND DOMESTIC HOT WATER PORTION OF SYSTEM NO. 3 IS IDENTICAL WITH SYSTEM NO. 5 ◗ USE FIGURE FOR SYSTEM NO. 5 WHICH IS $6.92 PER YEAR = J.	SAME AS FOR COMBINATION B.
S FOR COMBINATION C WERE TRANSFERRED I.	NOTE:- CITY WATER COSTS ALTHOUGH CONSTANT WERE SEPARATED FOR THE PURPOSE OF GRAPHICALLY ILLUSTRATING ON CHARTS I, I-A, I-B, I-C OPERATION AND MAINTENANCE ITEMS FOR WHICH THE OWNER DOES NOT FURNISH THE LABOR.	◗ SINCE THE COSTS OF GENERATING ELECTRIC CURRENT ARE THE COSTS OF FUEL AND LABOR OVER AND ABOVE THAT REQUIRED FOR HEATING THIS SUBSTITUTION IS PERMISSIBLE.	NOTES:- MAINTENANCE FACTORS FOR ELECTRIC GENERATOR ARE INCLUDED IN THE ELECTRIC CURRENT COSTS. NO MAINTENANCE COSTS WERE OBTAINABLE FOR ELECTRIC DISTRIBUTION LINES AND IN THIS STUDY WERE CONSIDERED AS ZERO.

Note: When electricity is purchased from Utility Companies at retail rates the individual meters are furnished and maintained by the Utility Companies.

c. Initial Horizontal Costs for Electric Lines

1. When electric current is individually metered.
2. " " " " sub-metered.
3. " " " " master-metered.
4. " " " " generated on the site.

For costs refer to Chart VII.

For description refer to Chart VII - item E VI.

Note: When electric current is generated on the site and individually metered, the generating plant is considered as a vertical cost and is included with initial vertical heat and domestic hot water costs.

Refer to Chart VIII - Systems 3 and 4.

The vertical electric lines, excluding meter pans and loops, do not materially change no matter how electric current is purchased, since when individual meters are used they are located in the halls outside each tenant's apartment.

This eliminates the necessity of individual risers from basement or ground floor to apartments.

Methods of substituting the variables heat, electricity and gas to arrive at rent per room per month for various combinations of variables.

The totals given on Charts V - VI - VII and IX as noted are those when heat is furnished by Owners Central plant and electric current and gas fuel are purchased from Utility Companies by tenant at retail rates. (For this combination refer to Charts I and I-A.)

Below these totals are given the interchangeable variations for different heating, gas and electric systems, which may be substituted for similar items above the total line.

The following key to the set up of master charts illustrates the methods of substituting variables, using the 6-story cantilever apartment as an illustration. (P. 29)

Grand total of rent per room per month - land excluded - When heat is furnished by Owners Central plant and electric current and gas are purchased from Utility Companies by tenant at retail rate - The electric current and gas charges are paid by the tenant in addition to the rent.

Combination I - Refer to Chart I.

By assembling all the items of initial and maintenance costs which go to make up rent per room per month by the method illustrated in "Key to the Set-Up" page 29 of this report and by applying financial factors noted on Chart II, the following cost totals are arrived at:

1. Total rent per room per month
2. Items paid by tenant to Utility Companies,(per room per month) in addition to the rent.
3. Total of rent per room per month plus items paid by tenant to Utility Companies.

Three Variations of Rent Per Room Per Month (Land Excluded) as caused by interchanging the Variables for heat, electricity and gas.

Each of Charts I-A, I-B and I-C* arrives at rent per room per month by different combinations of the variables for heat, electricity and gas as follows:

Chart I-A	Central Heating Plant - gas fuel and electricity purchased by tenant from Utility Companies at retail rates.
Chart I-B	Central Heating Plant - gas fuel and electricity purchased by owner from Utility Companies at wholesale rates, and included in rent.
Chart I-C	Central Heating and Owners Electric Generating plant - Gas fuel purchased by owner at wholesale rates.

In comparing these charts note that in all cases heat costs are reflected in the rent and that gas fuel and electric current costs are disposed of as follows:

Combination I-A	Tenant directly pays the gas fuel and apartment electric current cost to Utility Companies, at retail rates. The electric current costs for public space light and power are included in the tenant's rent.

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* The Guild arbitrarily chose to execute only three charts in which various methods of supplying heat, gas and electricity were interchanged. (Charts I-A, I-B and I-C) The combinations, too, were chosen arbitrarily.

Combination I-B	The gas fuel and the total electric current costs are included in the tenant's rent, being paid for by the owner at wholesale rates.
Combination I-C	The gas fuel and the public space electric current costs are included in the tenant's rent. The costs for current produced by the owner's plant, used within the apartment are paid by tenant to owner in addition to the rent.

On charts I-A, I-B and I-C are given only the initial costs (not reduced to rent) - operation and maintenance costs per year - items paid by tenant (per room per month) to Utility Companies and blank spaces are left for the insertion of the actual and vacancy allowance factors that exist for any particular operation.

Chart I-A is identical with Chart I except that in the latter a financial factor as described on Chart II is used to arrive at a rent per room per month. This was done to illustrate the reduction of results to a rental basis.

The diagrammatic set-up of items A, B, C, D, E, F, H, J and K are arranged for facility in inter-changing the various methods of providing and charging for heat, electricity and gas, and to show the separation of Operation items (such as water) for which the owners do not furnish the labor.

B-5. General Description of Vertical and Horizontal Elements - Operating Characteristics.

The items A, B, C, D, E, F, G, H, J and K appearing on Charts I, I-A, I-B, I-C and 2, correspond to the identically lettered items of description on the lower half of Chart VII. When variations occur within an item a description of each is given or reference made to the chart on which a description may be found.

Comparing Three Variations of rent per room per month - as caused by interchanging the variables for heat, electricity and gas. Chart No. II.

The combinations I-A, I-B, and I-C are respectively identical with those used for Charts I-A, I-B and I-C.

The items A, B, C, D, E, F, G, H, J and K are the same as the like lettered items of Charts I-A, I-B and I-C, excepting that on Chart II the items are reduced to rent per room per month by employing the financial factors noted on the Chart. For combination B and C the rent per room per month for each item is expressed as a difference - more cost or less cost than the corresponding items of combination I-A.

An analysis of the items shows A, H and J as constant, in the same story height building, for the three combinations. In item J - Heat and Domestic Hot Water - where comparison is made of central plant heat both with and without central plant electric current the heat and domestic hot water costs are constant since the cost of generating electric current is the cost of fuel and labor required to produce steam over and above that needed for heating purposes.

Of those items which are not constant in the same story height building for the three combinations, the following notes are given:

Item B: The initial vertical heating and domestic hot water costs for Combination I-B, is the same as for I-A, since in both cases the same system of heating is used. Costs for combination I-C are greater than for I-A, due to the inclusion of the electric generating plant and electric meters as a vertical initial cost. (The difference given in I-C is the cost of the electric generating plant and meters not including the distribution system, in terms of rent per room per month.

Item C: The initial vertical costs for gas lines are less in combination I-B and I-C than in I-A since, where gas is master metered one gas pipe riser may serve many apartments while I-A where gas is individually metered in the basement separate risers must lead to each apartment.

Item D: Vertical Initial Costs for electric Meters, Pans and Loops. The initial vertical electric wiring costs included as part of item A, are constant in the same story height buildings for all three combinations, since the costs of meters, pans and loops are separately given under item D, and hence for combination I-B where electricity is master metered there are no individual nor public space light and power meters, pans and loops and hence no costs. The costs for master meter pans and loops are included with the initial horizontal electric distribution system costs.

For combination I-A, costs are given for meter pans and loops for individual meters and public space light and power meters. The meters are furnished and installed by the Utility Companies.

The very slight difference between combination I-A and I-C, both of which require individual meter pans and loops, is caused by the absence of electric meters for public space light and power in combination I-C where electricity is generated in owner's plant and total current consumption readings are taken at the generator. Combination I-C also requires meters furnished by the owner. These costs are included with the electric generating plant under item B.

Item E: Initial horizontal project costs. The increase of costs for combination I-B over I-A and I-C over I-B are caused by the design of electric distribution systems for various methods of purchasing electricity.

For a general description of each refer to

Chart VII item E-VI-1 for combination I-A
" " " " " 2 " " I-B
" VIII - System of Heating 3 - Horizontal costs
Electric Feeders.

The heating distributing lines are identical in the same story height buildings for Combinations I-A, I-B and I-C. In combination I-C where heat and electricity is combined by the use of system 3 (Chart VIII) the electric distribution lines are additions to the heat distribution lines of system 5 used in combination I-A and I-B.

Items: F, G, H, J, K, Operation and Maintenance Costs.

The difference in operation and maintenance costs can best be analyzed by reference to Charts VIII, IX, X.

Notes Pertaining to the Basic Cost Charts

Charts V and VI (Initial Vertical Costs)

The addition of a basement is the greatest factor in the increase of cost per room for the 2-story apartment over that of the 2-story flat which has no basement.

The addition of a 2nd elevator is the greatest factor in the increase of cost per room for the 8-story apartment over that of the 6-story apartment which has one elevator.

Chart VII.

The water lines for the 2-story flat which are hung from the ground floor ceiling (under second floor) are covered to prevent condensation. The pipe covering causes increase in cost for the water lines of the 2-story flat over that of the 2-story apartment.

Prepared by

E. W. KLEE.

The Housing Study Guild, in the course of its Analytic Study, initiated a study of various methods of supplying heat. This was done so that definite information showing the advantages and disadvantages inherent in the various systems, when applied to a large scale undertaking, could be compiled.

Practically all the basic factors used in this study are derived from the experiences of the office of P. R. Moses, Consulting Engineer.

Basic Factors

1. The Project
2. Insulation of the Buildings.
3. Description of the Heating Systems.
4. Condensation of Steam.
5. Unit Factors of Cost.
6. Electricity.
7. Labor.
8. Fuel.
9. Results.

1. The Project

The hypothetical project studied comprises an area of one-eighth square mile. Refer to Site Plans. Chart III.

2. Insulation of the Buildings

Refer to the Specifications. Section 6.

Average Percentage of Window to Wall Area.

2 Story Flat	Window Area	19.5%	Wall Area	80.5%
2-3-4 Story Apts.	" "	32. %	" "	68. %
6-8-10-12 Story Apts.	" "	30. %	" "	70. %

3. Description of the Heating Systems

System No. 1.

Individual coal fired boilers in each building with a single pipe steam system. Cast iron radiators in the rooms and heating risers in the kitchens and baths. Domestic hot water can be generated by either an indirect water heater connected below the water line of the boiler or a separate cast iron water heater. Electricity to be purchased.

System No. 2.

Same as No. 1 except that the boiler is oil-fired and the water heating coil is submerged within the boiler under the water line so that it may produce hot water in summer as well as in winter.

System No. 3.

A central plant supplying medium pressure steam (50 lbs. per sq. in.) to reducing valves at each building from which a low pressure single-pipe steam system (the same as in system No. 1) is installed and low pressure connection is made to a hot-water tank equipped with steam coils. The central plant also generates electricity. This is distributed to given points at relatively high voltage where the voltage is reduced and the standard voltage is distributed to each building.

There are two such plants in the project and they are designed with spare units so that a continuous supply of steam and electricity is insured.

System No. 4. (Chadeayne System)

This system is the same as No. 3 except that the steam is converted (by means of converters, located in each building) into hot water. The buildings are equipped with hot water heating systems.

System No. 5.

This system is the same as No. 3 except that the electric generating plant is omitted.

4. Condensation of Steam

Theoretical figures on the number of pounds of steam condensed by a square foot of cast iron radiation in the New York area run as high as 650 pounds. As compared with this, actual operating records of apartment houses were available which showed the average condensation of steam per square foot of radiation for an average winter season (averaged from many winters) to be far less than 350 pounds. On the strength of this finding, a figure of 400 pounds per square foot per year was used.

A list of a few of the apartment houses surveyed follows:

235 E. 22nd St.	350	lbs. of steam per sq. ft. of rad. per yr.
315 E. 68th St.	336	" " " " " " " " " "
211 E. 35th St.	407	" " " " " " " " " "
Eldorado Apts. Central Park West	322	" " " " " " " " " "
LaBarranca Apts. Hastings on Hudson	380	" " " " " " " " " "
Academy Garden Apts.	370	" " " " " " " " " "

5. Unit Factors of Cost

Complete Steam Plant,	30000	lbs. Max. Hr. Demand	@	$2.60	per lb.
" " " ,	40000	" " " "	@	2.45	" "
" " " ,	50000	" " " "	@	2.40	" "
" " " ,	60000	" " " "	@	2.30	" "
" " " ,	70000	" " " "	@	2.20	" "
" " " ,	80000	" " " "	@	2.15	" "
" " " ,	90000	" " " "	@	2.05	" "

These figures show entire cost of complete boiler house with boilers, foundations, fuel burning system, piping and chimney.

Steam distribution averages 11% of the total cost of the steam plant, steam distribution and single-pipe steam system.

Single-pipe steam systems within the buildings average 56% of the total cost of the steam plant, distribution and single-pipe systems.

The cost per square foot of radiation runs from $1.30 to to $1.35 in the cantilever buildings, growing less as the buildings grow taller. The cost per square foot in the bearing wall building is $1.50.

12½% of the foregoing prices of radiation is for apparatus to generate domestic hot water.

The cost of the multiple unit steam-hot-water system is the same as for single-pipe steam systems insofar as the central steam plant and distribution are concerned, but the installation within the building is 12% greater than the single-pipe steam system when using 20% less radiation than is used by the single-pipe steam system. The higher water temperatures make this reduction in the amount of radiation possible.

In all the above figures on radiation, only the amount of actual standing radiators is used while the heating risers are "thrown in", so to speak. The heating risers average 20% of the total calculated surface required.

6. Electricity

The electric generating plant is estimated at $175 per K.W. maximum hour tenants demand. Due to the increased size of the plant required in the 6-8-10-12 story building, the cost of the plant would drop to approximately $120 per K.W. maximum hour tenant demand. To this, though, there is also added a high public lighting and elevator load which increases the size of the plant; but upon figuring the cost of the plant at the lower figure of $120 and enlarging it to take care of the additional public loads, it turns out to be the same net cost as estimating the private maximum hour demand at the higher figure of $175 per K.W. maximum demand hour.

The cost of electric distribution lines was based on the following figures:

2-story	bldgs.	300	K W Max. Hr.,	Distribution	Cost	$130.	per K W
4 "	"	484	" " " "	"	"	85.	" " "
6 "	"	550	" " " "	"	"	85.50	" " "
8 "	"	645	" " " "	"	"	80.75	" " "
10 "	"	705	" " " "	"	"	74.50	" " "
12 "	"	726	" " " "	"	"	73.	" " "

For low-cost housing the following basic figures were used:

200 KWH per room per year for tenants' use (Figures from Academy Housing, City and Suburban Homes, Lavanburg Homes);

Metering and billing @ 1/4¢ per KWH annual consumption.
(Figure from Engineering Supervising Co.)

Repairs and maintenance of electric plant and distribution @ $7.00 per 1000 KWH annual consumption.

Adding the sundry supplies, oil, water, etc., in connection with the generation of electricity, it came to 6.66 K.W.H. per one cent.

For systems "1" and "2", allowance for chimney and boiler room construction was made as follows:

2-story	buildings		$ 800
3	"	"	1,000
4	"	"	1,200
6	"	"	2,000
8	"	"	2,200
10	"	"	2,600
12	"	"	2,600

(These would be saved if central plant for steam, etc., was installed.)

In the consumption of electricity, the refriteration consumes 54% of the total tenants' use, and lighting 46%. However, when buying such electricity, since lighting is the first necessity and refrigeration the second, the lighting takes the higher first rates and refrigeration the successive decreasing rates with increased consumption. On New York and Queens service, this results in the lighting being charged with 54% of the bill and refrigeration with 46%.

When electricity is generated in a central plant, however, all electric current costs the same per K.W.H. There is no distinction made between that current consumed for lighting purposes and that consumed for refrigeration. Hence, the lighting and refrigeration take their true proportional charges in approximate direct ratio to current used, i.e., 3 cents per room per month for lighting and 4 cents per room per month for refrigeration (4 room apartments).

7. Labor:

The labor estimate for individual boilers in each building, coal fired, was made in conjunction with Mr. Engel of the J. H. Taylor Construction Company, as follows:

2-3 and 4 Story Buildings

4 boilers per man, days; 8 boilers per man, nights; 7 relief men.

The above for 7 months @ $70 per month.

10 hot water coal heaters per man per 24 hours. 2 relief men.

The above for 5 months @ 70 per month.

6 to 12 Story Buildings

It is estimated that these buildings will require 6 men per block on regular shifts and 6 men per block on a second shift, and 4 men for relief of the 12 regular men. These men rate $120 per month the year round.

Oil Burning Labor

With oil-burning it is calculated to keep a man on every block with all heights. These men to get $2,000 per year.

Central Plant Labor (Including Compensation Insurance)

The following figures were prepared by Mr. Moses, and show the labor required per year for a plant capable of generating the required number of pounds of steam in one hour, together with a breakdown to show the labor costs per year for each 1000 pounds of steam capacity per hour.

Central Steam Plant only, no electric generating plant;

28000	lbs.	$ 7,320	per	year,	or	$262	per	year	per	1000	lbs.
40000	"	7,950	"	"	"	199	"	"	"	1000	"
50000	"	7,950	"	"	"	159	"	"	"	1000	"
70000	"	10,120	"	"	"	145	"	"	"	1000	"
90000	"	16,790	"	"	"	186	"	"	"	1000	"

Central Steam and Electric Generating Plant:

(Including Compensation insurance).

28000	lbs.	$10,282	per	year,	or	$368	per	year	per	1000	lbs.
40000	"	10,900	"	"	"	272	"	"	"	1000	"
50000	"	10,900	"	"	"	218	"	"	"	1000	"
70000	"	15,850	"	"	"	226	"	"	"	1000	"
90000	"	16,790	"	"	"	186	"	"	"	1000	"

8. Fuel:

In system #2, the 6, 8, 10, 12 story buildings, #5 oil with 150,000 Btu. per gallon and 5 cents per gallon burned at 70% efficiency, makes steam at a cost of 50 cents per 1000 pounds.

In system #2, the 2, 3, 4 story buildings, #6 oil with 146,000 Btu. per gallon and at 4 cents per gallon, makes steam at a cost of 36 cents per 1000 pounds.

In system #1, #2 Buck coal with 12,000 Btu. per pound and at $6.00 per 2000 lbs., burned at 50% efficiency, makes steam at a cost of 50 cents per 1000 pounds.

In systems #3, 4 and 5, steam from a central plant was estimated to cost 40 cents per 1000 lbs.

9. Results:

This study proved the central plant systems capable of making an important reduction in the rent as compared with individual boiler plants in each building.

The largest saving is made because the electricity is a by-product of the heating and hot water load and therefore costs much less than when it is purchased from a utility company.

Prepared by
G. D. CHADEAYNE.

System I:

The boiler is to be of the enclosed fire-box low-pressure return tubular type equipped with dumping grates having 1/8" openings, and be provided with blowers and automatic air admission control to permit burning of cheap coal.

The radiators shall be cast iron of the proper height, to be placed under the windows.

Each radiator shall be equipped with a supply and an air valve.

The shut-off valves in the pipe lines shall be gate valves.

All fittings shall be black cast iron of standard weight.

In buildings above six stories, each riser shall be equipped with anchors and an expansion joint or proper pipe loop.

All mains and risers, except where used as heating surface, containing steam, shall be insulated with standard thickness heat-insulating covering.

System 2:

Shall be the same as System 1, except that the boiler shall be equipped with a mechanical atomizing gun type oil burner to burn number five oil without pre-heating for boilers under 75 HP, and with rotary cup burners, electric and steam heaters to heat oil to 180° for burning No. 6 oil; together with the proper installation of an oil-storage tank sized to carry a supply for at least two weeks in severe weather, and properly buried outside of the building and equipped with an auxiliary pump to deliver oil to a fifty-gallon tank located in the basement, to comply with Underwriters and authorities.

Systems 3 and 4:

Central boiler and electric generating plant boilers shall be of the water-tube type for 400 pounds working pressure, equipped for burning heavy oil or pulverized coal, and with super-heaters for total heat of 750° at 200% of rating, soot blowers, pyrostats, dust catchers, steam and feed-water meters, high and low water alarms, pressure gauges, draft gauges, automatic draft control, air pre-heaters, breeching visualizers, breechings and stacks. The boiler room shall be planned for equipment with coal-handling apparatus even if oil is to be the immediate fuel.

Where plant is of sufficient size, arrangements shall be made to operate one or more boilers at low pressure, to provide steam not available from exhaust.

The steam for distribution for the heating and hot water shall be bled from the steam turbines at from 10 to 50 pounds pressure, depending upon weather conditions, and carried directly into the distribution main. Where condensation water is available and the load warrants, one or more turbine units will be equipped to operate condensing with steam extracted for heating water, etc.

The distribution steam main and return shall be run at least 3 feet under ground between the buildings in the regulation Ric-Wil material. The distribution mains shall be run through the cellars of the buildings where possible, being underground only between the buildings. The distribution mains shall be equipped with anchors and expansion joints in the cellars of the buildings. The distribution mains shall be connected at the end of the run and properly valved, The distribution and return mains shall be of steel, welded at all joints and branch connections and drip joints.

Single seated, pilot controlled pressure reducing valves shall be provided on the branch supply from the steam main for System 3.

For System 4 no pressure reducing valves shall be used.

For System 3 the distribution system, radiators, valves and so forth, shall be the same as System 1.

For System 4 (Chadeayne system of steam-hot-water supply), the distribution system within the building shall be a two-pipe closed hot water system with high pressure test convection radiators, hot-water compression type radiator valves and union elbows.

The water shall be heated at the base of each group of risers by steam in the heat transfer apparatus.

System 5 shall be exactly the same as System 3, except that all electrical generating and distribution lines shall be eliminated.

The current shall be generated by multi-stage steam turbines direct-connected to A.C. generators with direct-connected exciters. Current will be generated at 6600 volts or 2300 volts, or at 480 volts or 240 volts; 3 phase, 60 cycles, depending on distances to be covered.

Each of the units shall be connected to a fully equipped generator panel through main leads of ample capacity to prevent excessive drop in potential and to withstand short circuit current.

The switchboard shall be preferably constructed from ebony asbestos or slate, properly mounted on a 6-inch channel beam and braced from the wall.

Leads from each generator shall carry current through a circuit-breaker mounted in the back of the switchboard to bus bars.

The generator panel shall have mounted on it the following instruments:

Ammeter, with 3 circuit ammeter switch, in order to read the amperes in all three phases;

Indicating Watt Meter to indicate power being developed by the unit;

Reactive Kilovolt Ampere Meter to facilitate the proper division of load between the units.

At one end of the switchboard, a swinging bracket shall be mounted containing a synchronoscope, synchronizing lamps, two A.C. volt meters and a frequency meter. One of the volt meters shall be provided with plug switches. Also synchronizing plugs shall be located on each generator panel. The frequency meter shall be permanently connected to the bus.

A voltage regulator shall be provided on the switchboard.

Automatic frequency control apparatus shall be mounted on the switchboard to regulate the speed of one of the units so that the clocks connected to the circuit shall maintain the correct time.

The frequency control can operate any unit chosen by the operator and the other units operating in parallel shall be controlled by automatic load control potentiometers.

A watt-hour meter shall be connected on the circuit supplying the power house auxiliaries.

There shall be a totalizing watt-hour meter connected in the main bus circuit.

There shall be a totalizing recording watt meter.

There shall be a circuit breaker mounted on the generator switchboard for each circuit of distribution cables.

The distribution cables shall be 3 conductor cables with either rubber or varnished cambric insulation and lead covered. The cables shall be pulled inside of fibre ducts. The fibre ducts shall be run in duplicate with one duct left empty. The fibre ducts shall be surrounded with poured concrete when run underground between the buildings, about 2 feet below the surface. The fibre ducts shall be placed in the poured concrete foundation walls of the building. The cables shall have sufficient capacity to carry the estimated future increased load with drop in potential not to exceed 2%. These cables shall be connected to disconnecting switches in the transformer vaults.

The transformers shall be located in a ventilated and fire-proof vault and doors kept locked. The distribution to the transformers shall be 3-wire, 480 volts, and from the transformers, shall be 4-wire, 120/208 volts.

Prepared by
G. D. CHADEAYNE.

2-Story Flat - Bearing Wall Construction - No Basement.

Excavation

Hand excavation for wall, and entrance stoop foundations - disposal of excess earth - back filling and tamping.

Rough Grading

It is assumed that the site is comparatively level, that the rough grading entails only the labor of leveling the ground to 6" below finished grade and for a horizontal distance of 10 feet away from the building.

Footings and Foundations

Footings and foundations to point 4'-0" below finished grade for outside walls and to 1st floor level for interior walls stone concrete 1, 2, 4 mix - wood form work.

Integral Water proofing

Concrete for footings and foundations of outside walls to contain hydrated lime in the proportion of 1-ton of lime to 75 cu. yds. of concrete.

Cinder concrete floor on ground (First floor, entrance hall and entrance stoop).

Cinder fill 6" deep well tamped to receive concrete - cinder concrete 1-3-5 mix 4" deep - 1" finish 1-2 mix trowelled to a smooth hard finish. - 1½" cork board dipped in asphalt applied to concrete.

Second Floor Construction

Pressed metal 8" deep open truss joists placed 2 ft. on centers. Metal back-rip lath over joists to receive 2" cinder concrete 1-3-5 mix and 1" integral finish 1-2 mix trowelled to a smooth hard finish. Metal lath and plaster under side of joists.

Roof Construction

Pressed metal 10" deep open truss joists placed 6 ft. on centers-6" ferro board 28 gauge metal - 1" Thermax insulation laid in mastic - screeded cinder concrete roof fill 1-3-5 mix pitched to a 2" minimum - three ply tar and gravel composition roof - 10 years guarantee - copper leader box - copper gravel stops in lieu of parapets - felt flashing around roof access scuttle. Underside of pressed metal open truss joists metal lathed and plastered.

Exterior Bearing Walls

8" thick selected common brick walls - metal furring strips at inside of wall with paper backed metal lath - three coats of plaster - interior of walls painted with mastic water proofing - precast stone window and door sills.

Interior Bearing Walls

8" thick common brick walls for interior bearing walls and for party walls between every second unit (107' - 8" O.C.) - three coats of plaster both sides.

Hollow tile partition walls.

Partitions between apartments and around kitchens - 6" hollow tile, 3 coats plaster both sides.

Interior stair-well walls to be of 6" hollow tile glazed stair-well side and 3 coats plaster room side, - 4" hollow tile glazed both sides, between flights of stairs, 4" hollow tile glazed stair-well side and 3 coats of plaster first floor entry side.

Solid Plaster partitions

Partitions between rooms - pre-fabricated sections of supported metal lath with frames for openings, 3 coats plaster each side forming solid partition. Thickness of finished partition 2".

Steel lintels and beams

Angle lintels over all door and window openings in masonry walls. I-beams for long spans where required.

Stairs

Standard steel stairs - strings and fascias 3/16" pressed steel channels - risers and sub-treads, 12 gauge metal - header channels where necessary - newels plain square cast iron or seamless drawn tubing with C.I. cap - Balusters 1/2" square iron bars 4" O.C. with channel sub-rails top and bottom with half round hand rail - shop coat red lead - intermediate platforms and treads cement finish. Wood wall hand rails (round) with iron brackets.

Steel sash and glazing

Steel casements 1" section baked on enamel finish. Muntin divisions giving approximately 10" X 12" lights.

Ventilators of a size and quantity to adequately comply with the New York building code - applied hardware including window shade brackets. Glazed with double thick quality B glass back puttied and set with clips and puttied with steel sash putty. Steel interior side jambs and window sills.

Wood Work

Floors

All apartment rooms, halls and closets excepting bath rooms - oak floor 7/8" thick (rectangular pattern) laid in mastic. Oak saddles at doors.

(Entrance vestibules and stair landings cement floors)

Trim - Gum Wood

All apartment rooms, halls and closets - 1 3/4" door frames with solid mould, 1 3/8" veneer 5 panel door, 4" wood base board (except bath room) and picture mould.

Kitchen cabinet (standard) 5 ft. wide with glazed door above. 15" broom closet with shelf over.

Metal doors

First floor entrance door to stair hall and to individual entries - single swing furniture steel covered doors with 15 lights of glass and combination steel buck and trim.

Second floor entrance door between stair hall and apartments single swing furniture steel covered doors and combination steel buck and trim. (not glazed)

Hardware

Exterior building doors 1½ pr. brass butts, knobs, plate and cylinder lock set and door closer. Locks to be master - keyed to apartment locks.

Interior apartment entrance doors - 1½ pr. steel butts, brass knobs, plate and cylinder lock set.

All other interior doors - 1 pr. steel butts, brass knob, rose and latch. Bath room doors to have thumb bolt.

Standard Hardware for kitchen cabinets. Windows and metal wardrobes will be complete with hardware. Apartment entrance doors Bommer hinges; building entrance doors to have checks.

Tile Work

Bath rooms - tile floor, 6" sanitary tile cove base and tile ring under toilet.

Painting

Interior walls, (excepting glazed hollow tile walls) doors and exterior doors, trim and kitchen cabinets - two coats lead and oil.

Ceilings - one coat of Sunflex.

Wood floors-scraped and two coats of shellac.

Steel windows - two coats of lead and oil both sides.

All iron work of steel stairs - 2 coats of lead and oil.

Miscellaneous equipment

Window shades

Metal Medicine cabinet enamelled finish with mirror.

Metal Wardrobes - 3 ft. section - two per bed room excepting in five room apartment where one bed room has only 1 section.

Electric Refrigerator 24 inches square and 51" high - 4.7 cu. ft. storage capacity - 9.2 sq. ft. shelf area - two ice trays - 1/6 H.P. motor.

Gas Range 24" square with 4 burners, broiler and oven.

Electric Wiring

One ceiling outlet in each room - pull chain excepting living room outlet which has wall switch.

One base board outlet in each room excepting bath room and kitchen.

Power outlet in kitchen for refrigerator and wall outlet 4 ft. from floor convenient to kitchen table.

Over head outlet at stair platforms - switched.

B. X. conduit concealed.

For meters, meter pans and loops, refer to Chart VII item D.

For horizontal elements refer to Chart VII item E VI.

Plumbing

Hot Water lines	--	Recirculating system - brass pipe -
Cold Water line	--	steel pipe.
Gas lines	--	steel pipe.
Soil lines	--	cast iron pipe.
Rain leaders	--	wrought iron pipe.
Vents	--	cast iron pipe.

Fixtures.

Combination 42" long sink and wash tray of enameled iron.

Lavatory 20" vitreous.

Recessed enameled iron bath tub 5'-0" long.

Syphon jet closet, wood seat and flush valve.

For metering of gas refer to Chart VII item C. For horizontal elements refer to Chart VII items E - III, E - IV and E - V.

Heating - Refer to Chart VIII.

2-3 & 4 Story Cantilever Apartment. (Full Basement)

Excavation

Steam shovel excavation for basement - hand excavation for wall and pier footings and entrance stoop foundation - disposal of excess earth - back filling and tamping.

Rough Grading

It is assumed that the site is comparatively level, that the rough grading entails only the labor of leveling the ground to 6" below finished grade and for a horizontal distance of 10 feet away from the building.

Footings and Foundations

Stone Concrete - 1-2-4 mix - Wood form work.

Structural Steel

The structural steel columns, with integral structural steel head, spaced 15 feet to 18 feet on centers comprises 2½ lbs. per square foot for the 2-Story Unit to 5 lbs of structural steel per square foot of floor area for the 12 Story Unit.

All Structural Steel to conform to the Standard Specification of the American Society for Testing Materials, Serial Designation A9-24 for "Structural Steel for Buildings".

The Column Head channels to be forged or preformed to the 45° angle bend and attached to the column section with field bolts in accordance with the typical details so as to develop the full bending moment and shears developed by the relative rigidity of column section and floor slab.

Integral Water proofing

Concrete for footings and foundations of outside walls to contain hydrated lime in the proportion of one ton of lime to 75 cu. yds. of concrete.

Cinder concrete floor on Ground (Basement Floor)

Cinder fill 6" deep, well tamped to receive concrete - cinder concrete 1-3-5 mix 4" deep - 1" integral finish 1-2 mix trowelled to a smooth hard finish.

Cinder Concrete entrance stoop and steps.

Cinder fill - Cinder concrete 1-3-5 mix - 1" integral finish, 1-2 mix trowelled to a hard smooth finish - foundation walls stone-concrete - 1-2-4 mix.

Structural floor and roof slabs

(For system of construction see: "Structural Frame for the 2-3-4-6-8-10-12 story apartments". Page 14 of the report)

6" thick 1-2-4 mix stone concrete with two way steel reinforcing - wood form work (ply wood used for under side of slabs.)

Reinforcement

All reinforcement shall be arranged in continuous bands with splices located where indicated on typical plans of deformed round or square bars conforming to the Standard Specifications of the American Society for Testing Materials for "Billet-Steel Concrete Reinforcement Bars of Intermediate Grade", Serial Designation A-15-14.

The average quantity of all reinforcement including walls and wind bracing comprises 2½ lbs per square foot of floor construction for the 2-Story Unit to 3 lbs per square foot for the 12-Story Unit.

Insulation of First floor slab.

1½"thick cork board dipped in asphalt applied to entire first floor slab.

Insulation for roof slab and bulkhead roof slab

1" thick THERMAX laid in mastic.

Roof - including bulkhead roof

Apply over Thermax screeded cinder concrete fill 1-3-5 mix pitched to a 2" minimum at roof drain - three ply tar and gravel composition roof 10-year guarantee - copper leader box - copper gravel stops (2-story apartment only)

Cant strips and felt flashing at copings and bulkhead (3-4 story apartments only) - copper gravel stops bulkhead roofs (3-4 story apartments only)

Exterior Curtain Walls

All exterior walls excepting stair hall enclosure - 3 5/8" X 1 3/4" metal studs filled with nail crete spaced 16" O.C. and same stud for framing of openings - Metallated Ecod Fabric applied to studs both outside and inside - three coats of plaster inside and three coats integrally tinted stucco plaster outside.

Exterior Hollow Tile Walls

8" Hollow tile glazed both sides for projecting portion of stair hall.

Interior Hollow tile walls

6" Hollow tile glazed both sides for stair hall. (to roof of bulkhead for 3-4 story apartments only)

6" Hollow tile not glazed between apartments for party walls between building units, and for partition in basement.

Parapets at roof for 3-4 story apartments only

8" hollow tile glazed roof side stuccoed outside - coping, salt glazed tile.

Brick Work

Common brick for incinerator combustion chamber and flue. (3-4 story apartments only) all lined with fire brick for a distance of 30 feet above incinerator combustion chamber.

Stairs

Flight from 1st floor entrance to basement reinforced stone concrete 1-2-4 mix.

Stairs from 1st floor entrance on up; Standard steel stairs - strings and fascias 3/16" pressed steel channels - risers and sub-treads, 12 gauge metal - header channels where necessary - newels plain square cast iron or seamless drawn steel tubing with C.I. cap. Balusters 1/2" square iron bars 4" o.c. with channel sub-rails top and bottom with half round hand rail stop coat red lead - intermediate platforms and treads cement finish. Wall hand rails (round) wood with iron brackets.

Steel sash and glazing

Steel casements 1" sections baked on enamel finish, muntin divisions giving approximately 10" X 12" lights - ventilators of a size and quantity to adequately comply with the New York building code - applied hardware including window shade brackets - steel interior side jambs and window sills - excepting in basement - glazed with double thick quality B glass set with clips in steel sash putty.

Solid Plaster Partitions

Interior partition other than hollow tile - pre-fabricated section of supported metal lath with frames for openings with 3 coats plaster each side. Thickness of finished partition 2".

Plastering

In addition to plaster work already mentioned - 3 coats plaster on all hollow tile partitions except where glazed, and in basement. (Concrete ceilings not plastered) Three coats of plaster at brick flues and on metal lath applied around steel columns.

Stucco

In addition to stucco work already mentioned - 3 coats integrally tinted stucco on metallated lath at exposed ends of floor slabs.

Tile Work

Bath rooms - tile floor, 6" sanitary tile cove base and tile ring under toilet.

Wood Work

Floors

All apartment rooms, halls and closets excepting bath rooms - oak floor 7/8" thick (rectangular pattern) laid in mastic. Oak saddles at doors.

(Stair Hall entrance platform and stair landings cement floors)

Trim - Gumwood.

All apartment rooms, halls and closets - 1 3/4" door frames with solid mould, 1 3/8" veneer 5 panel doors, 4" wood base board (except bath room) and picture mould.

Kitchen cabinet (standard) 5 ft. wide with glazed door above - 15" wide broom closet with shelf over.

Yellow pine - Perambulator bins in basement.

Metal Doors

First floor entrance door, out doors to stair halls and door between bulkhead and roof - Single swing furniture steel covered doors with 15 lights of glass and combination steel bucks.

Entrance doors between stair hall and apartments and basement doors - Single swing furniture steel covered doors and combination steel buck (not glazed)

Hardware

Exterior building entrance doors and doors between bulkhead and roof - 1½ pr. brass butts, knobs, plate and cylinder lock set, and door closer. Locks to be master keyed to apartment locks.

Interior apartment entrance doors and basement doors - 1½ pr. steel butts, brass knob plate and cylinder lock set.

All other interior doors 1 pr. steel butts, brass knob, case and latch. Bath room doors to have thumb bolt.

Standard hardware for kitchen cabinets.

Windows and metal wardrobes will be complete with hardware.

Metal exterior window sills.

All apartment entrance doors Bommer spring hinges; building entrance doors to have checks.

Painting

Interior walls above basement excepting glazed hollow tile walls, doors and exterior doors, trim and kitchen cabinets - two coats lead and oil.

Ceilings - one coat of Sunflex on concrete.

Basement walls and ceilings - one coat of white wash.

Basement doors and trim and perambulator bin partition - 2 coats lead and oil.

Wood floors - scraped and two coats of shellac.

Steel windows - two coats of lead and oil both sides.

All iron work of steel stairs - 2 coats lead and oil.

Miscellaneous equipment

Window shades.

Metal medicine cabinet enamelled finish with mirror.

Metal wardrobes - 3 ft. section - two per bed room.

Electric refrigerator - 24 inches square and 51" high. 4.7 cu. ft. storage capacity - 9.2 sq. ft. shelf area - two ice trays - 1/6 H. P. motor.

Gas Ranges

24" square with 4 burners, broiler and oven.

Incinerators for 3-4 story apartments - Equipment for combustion chambers and hopper doors two at each apartment floor.

Electric Wiring

One ceiling outlet in each room - pull chain excepting living room outlet which has wall switch.

One base board outlet in each room excepting bath room and kitchen.

Power outlet in kitchen for refrigerator and wall outlet 4 ft. from floor convenient to kitchen table.

Over head outlets at stair platforms and key switched in basement.

Outlets and two switches in basement.

B. X. conduit concealed.

For meters, pans and loops refer to Chart VII - item D.

For horizontal elements refer to Chart VII - item E-VI.

Door opener to front door. U.S. specification mail boxes in entrance.

Plumbing

Hot Water Lines - Recirculating system - brass pipe.
Cold Water Line - Steel pipe.
Gas Lines - Steel pipe.
Soil Lines - Cast Iron pipe.
Rain leaders - Wrought iron pipe.
Vents - Cast iron pipe.

Fixtures

Combination 42" long sink and wash tray of enameled iron.

Lavatory 20" vitreous.

Recessed enameled iron bath tub 5-0" long -

Syphon jet closet, wood seat and flush valve.

One 20" X 24 enamel iron slop sink in basement of each unit.

For metering of gas refer to Chart VII item C. For horizontal elements refer to Chart VII item E-III, E-IV and E-V.

Heating

Refer to Chart VIII.

Note: The two story cantilever apartment has no incinerators, bulkhead or parapet walls.

6-8-10-12 Story Elevator Apartments (Partial Basement)

Excavation

Steam shovel excavation for basement - trench machine excavation for foundation walls of excavated portion - hand excavation for walls and pier footings, and entrance stoop and step foundations and area for exterior stairs to basement - disposal of excess earth - back filling and tamping.

Rough Grading

Same as for 2-3-4 story apartments.

Footings and Foundations

Same as for 2-3-4 story apartments.

Structural Steel

Same as for 2-3-4 story apartments.

Integral Water proofing

Same as for 2-3-4 story apartments.

Cinder Concrete floor on Ground (Basement Floor)

Same as for 2-3-4 story apartments.

Cinder Concrete entrance stoop and steps and outside stairs to basement.

Cinder fill, cinder concrete 1-3-5 mix - 1" integral finish, 1-2 mix trowelled to a hard smooth finish - foundation walls - stone concrete 1-2-4 mix.

Structural floor slabs and roof slabs.

Same as for 2-3-4 story apartments.

Reinforcement

Same as for 2-3-4 story apartments.

Insulation of First floor slab

Same as for 2-3-4 story apartments.

Insulation for roof slab and pent house roof slab

Same as for 2-3-4 story apartments.

Roof including pent house roof and building entrance roof.

Apply over Thermax, screeded cinder concrete fill (1-3-5 mix), pitched to a 2" minimum at roof drain - three ply tar and gravel composition roof, 10 year guarantee - copper leader box - copper gravel stops for pent house and incinerator draft retarding chamber roofs. Cant strips and felt flashing at all intersections of roof with wall. Copper gutter and leader at building entrance.

Exterior Curtain Walls

Same as for 2-3-4 story apartments.

Exterior Corridors

Seamless steel tubing posts securely anchored into floor slabs top and bottom - 3' - 6" railing between posts of 2" steel channels top and bottom with corrugated cement asbestos between thoroughly cemented into hollow of channel. 1" angle (asphalt floor stop) at outside edge of slab with copper drip at outside of slab drawn over angle and under asphalt flooring - copper flashing for railing posts - corridor slab pitched to outside to receive 1" asphalt mastic floor covering with 6" asphalt base at apartment enclosing wall side of corridor.

Exterior Hollow tile Walls

6" Hollow tile at entrance. Parapets at roof - 8" hollow tile glazed roof side - 3 coats integrally tinted stucco outside. Coping, salt glazed tile.

Interior Hollow tile Walls

6" Hollow tile walls glazed both sides between stair well and (elevator and stair hall) and between stair well and outside above roof.

6" Hollow tile walls glazed one side with glazed side showing in (elevator and stair Hall) and Stair well.

6" Hollow tile walls glazed outside for pent house and draft retarding chamber on roof.

6" Hollow tile walls not glazed for partitions between apartments, party walls between building units, partitions in basement and partitions between elevator machine room and incinerator draft retarding chamber.

Solid plaster partitions

Same as for 2-3-4 story apartments.

Brick Work

Common brick for incinerator combustion chamber and flue, all lined with fire brick for a distance of 30 ft. above incinerator combustion chamber.

Stairs

Interior stairs from first floor to basement - reinforced stone concrete, 1-2-4 mix.

Interior stairs from first floor on up to pent house, Standard steel stairs - strings and fascias 3/16" pressed steel channels - risers and sub-treads, 12 gauge metal - header channels where necessary - newels plain square cast iron or seamless drawn steel tubing with C. I. cap. Balusters 1/2" square iron bars 4" o.c. with channel sub-rails top and bottom with half round hand rail, shop coat red lead - intermediate platforms and treads cement finish. Wood wall hand rails (round) with iron brackets.

Exterior stairs for 6 story elevator apartment - extending from grade to roof - standard fire escape stairs.

Steel Sash and glazing

Steel casements 1" sections baked on enamel finish, muntin divisions giving approximately 10" X 12" lights - ventilators of a size and quantity to adequately comply with the New York building code - applied hardware including window shade brackets - steel interior side jambs and window sills - excepting in basement and pent houses - glazed with double thick quality B glass set with clips in steel sash putty.

Plastering

In addition to plaster work already mentioned - 3 coats of plaster on all hollow tile partitions except where glazed, in pent house and in basement - Furred metal lath and plaster ceiling under roof for the 8-10-12 story apartments. (Concrete ceilings not plastered) - 3 coats of plaster at brick flues and on metal lath applied to steel columns.

Stucco

In addition to the stucco work already mentioned - 3 coats integrally tinted stucco on metallated lath at exposed ends of floor slabs, hollow tile work at entrance - miscellaneous masonry work at outside of building above bottom of first floor slab.

Tile Work

Same as for 2-3-4 story apartments.

Wood Work

Same as for 2-3-4 story apartments.

Metal Doors

Main Entrance Door and door from pent house to roof - Single swing furniture steel covered doors with 15 lights of glass and combination steel bucks.

Doors between First Floor Entrance Hall and Outside corridor - doors between elevator and stair Hall and outside corridors - single swing furniture steel covered doors with 15 lights of glass with metal glazed transom over combination steel bucks.

Apartment entrance doors, doors to stair well and basement doors - single swing furniture steel covered doors and combination steel buck (not glazed.)

Hardware

Main Entrance Door, door from pent house, door between first floor Entrance hall and Outside Corridor, and doors between (Elevator and Stair Hall) and outside corridor.

1½ pr. brass butts, knobs, plate and cylinder lock set and door closer. Locks to be master keyed to apartment locks - hardware for pivoting transoms where required.

Apartment entrance doors and basement doors - 1½ pr. brass butts, brass knob, plate and cylinder lock set.

All other doors excepting elevator doors - 1 pr. steel butts, brass knob, rose and latch. Bath room doors to have thumb bolt.

Standard hardware for kitchen cabinets.

Windows and metal wardrobes will be complete with hardware.

Apartment entrance doors Bommer hinges, building entrance doors to have checks.

Elevators

6 - Story Apartments

1 - 1800 lbs. capacity, 100 ft. per minute.

Collective automatic control.

8 - Story Apartments

2 - 1800 lbs. capacity, 100 ft. per minute duplex collective automatic control.

10 - Story Apartments

2 - 1800 lbs. capacity, 150 ft. per minute duplex collective automatic control.

12 - Story Apartments

2 - 1800 lbs. capacity 150 ft. per minute duplex collective automatic control.

All elevators - cars to have power operated sliding panels. Hatch to be provided with single swing manually operated hollow metal doors, provided with bronze knob hall side, recessed drop ring shaft side, and door closer - combination metal buck - cast iron saddle.

Painting

Interior walls above basement excepting glazed hollow tile walls, doors and exterior doors, trim and kitchen cabinets - two coats lead and oil.

Ceilings - one coat of Sunflex on concrete..

Basement, pent house and elevator shafts, walls and ceilings - one coat white wash.

Basement doors and trim perambulator bin partition - 2 coats lead and oil.

Wood floors - scraped and two coats of shellac.

Steel windows - two coats of lead and oil both sides.

All iron work of steel stairs - 2 coats lead and oil.

Miscellaneous equipment

Window shades

Metal medicine cabinet enameled finish with mirror.

Metal wardrobes - 3 ft. section - two per bedroom.

Electric Refrigerator - 24 inches square and 51" high. 4.7 cu. ft. storage capacity - 9.2 sq. ft. shelf area - two ice trays - 1/6 H.P. motor.

Gas Ranges - 24" square with 4 burners, broiler and oven.

Incinerator equipment for combustion chamber, hopper doors, and 18" X 24" cast iron access doors to draft retarding chambers.

Iron ladders in pent houses.

Fire lines with hose and rack in each floor (including basement) of elevator and stair halls for 8-10-12 story apartments.

Electric Wiring

One ceiling outlet in each room - pull chain excepting living room outlet which has wall switch.

One base board outlet in each room excepting bath room and kitchen.

Power outlet in kitchen for refrigerator and wall outlet 4 ft. from floor convenient to kitchen table.

Over head outlets at stair platforms and in basement - key switched.

Outlets and two switches in basement.

Power outlets and wiring for elevators.

Power outlets and wiring for water pumps for 8-10-12 story apartments.

BX conduit concealed.

For meters, pans and loops refer to Chart VII - item D.

For horizontal elements refer to Chart VII E - VI.

U. S. specification mail boxes in entrance.

Buzzer at apartment entrance doors.

Plumbing

Hot Water Lines - Recirculating system - brass pipe.
Cold Water Line - Steel Pipe.
Gas Lines - Steel Pipe.
Soil Lines - Cast Iron Pipe
Rain leaders - Wrought Iron Pipe.
Vents - Cast Iron Pipe.

Fixtures

Combination 42" long sink and wash tray of enameled iron.

Lavatory 20" vitreous.

Recessed enameled iron bath tub 5-0" long.

Syphon jet closet, wood seat and flush valve.

One 20" X 24" enamel iron slop sink on every other floor in closet off elevator and stair hall.

For metering of gas refer to Chart VII, item C. For Horizontal elements refer to Chart VII, items E-III, E-IV and E-V.

Water tanks (Wood)

Provide water tanks with tell tales and over flow as follows:

6	story	apartment	-	none.	
8	"	"	-	11,800 gal.	capacity.
10	"	"	-	13,500 "	"
12	"	"	-	15,500 "	"

In each case provide in basement a water hoister pump of proper capacity. Cold water lines from tank are distributed in furred space under roof.

Fire lines with hose and rack in each floor (including basement) of elevator and stair hall for 8-10-12 story apartments.

Heating

Refer to Chart VIII.

SECTION VII - WAGE SCALES USED BY CONTRACTORS AS OF MAR. 31, 1934. N.R.A. CODE 8 HOUR DAY

Barney - Ahlers

Excavation

Steam Shovel Engineer	$66.00	- 5 day Week
" " helper	9.00	
Labor foreman	10.00	
Laborers	6.60	

Concrete Work

Foreman	12.00
Laborer	7.50
Carpenter	11.20
Carpenter's helper	7.50

Brickwork

Bricklayer	12.00
Bricklayer's helper	7.20

Taylor - Fichter:

Steel Erection

Foreman	22.00
Hoist Engineer	13.60
Steel Erectors	13.20
Helper	8.00
Painter	10.25

Detroit Steel Products:

Setting of steel sash

Mechanic	11.40

George Colon Foundation Corp.

Foundation Work

Steam Shovel	12.00
Bricklayer	12.00
Carpenter	10.00
Laborer	8.00

New York Roofing Co.

Roofing

Foreman	$10.75
Roofers	10.25

Fairfax Partition and Construction Co.

Plastering

Metal lathers	11.20
Plaster Foreman	13.00
Plasterer	12.00
Laborer	8.50

Douglas Iron Works

Iron Work (Steel Stairs)

Field -	Mechanic	11.20
	Helper	8.25
Shop -	Mechanic	6.00
	Helper	4.00

Hudson Painting Decorating Co.

Painting and Decorating

Painter	10.28

E. J. Electrical Installation Co.

Electric Work

Electrician	11.40
Helper	8.00

H. Mann Flooring Co.

Hardwood Flooring

Carpenter	11.20
Helper	8.00

Geo. E. Gibson Co.

Plumbing

Plumber	$12.00
Helper	7.00

P. R. Moses

Heating

Steamfitter	11.20
Helper	8.25

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SECTION VIII - PRICES OF SOME BASIC BUILDING MATERIALS AS OF MARCH 31, 1934.

Common Brick	$12.75	per M.
Cement (in paper bags)	2.40	
Sand	1.50	per C.Y.
Gravel	2.50	per C.Y.
Lime.....Hydrated	19.00	per ton
Common Hydrated	15.00	" "
Pulverized or lump	20.00	" "
Structural Steel Fabricated (at warehouse)	65.40	" "
Reinforcing Bars (base 3/4" Ø)	47.40	" "
Rough Lumber (Pine)	36.50	per 1000 bd. ft.
Copper (Rolled. Base price)	.07	" " lb.
Roofing (in place) Johns-Manville 3 ply	.073	" " sq. ft.
Glass	.10	" " sq. ft.

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